Passenger Vehicles & Light Trucks

Passenger Vehicles & Light Trucks

Vehicles under 10,000 lbs. (4,500 kg) Gross Vehicle Weight Rating

1999 INSPECTION HANDBOOK

Includes Recommended Procedures
for the United States and Canada

AAMVA

Published by the
American Association of Motor Vehicle Administrators

CCMTA • CCATM

In Partnership with the
Canadian Council of Motor Transport Administrators

Contents

Introduction

The American Association of Motor Vehicle Administrators (AAMVA) in partnership with the Canadian Council of Motor Transport Administrators (CCMTA) is proud to offer this section of the new, expanded edition of the *Vehicle Inspection Handbook Set,* with recommended minimum inspection procedures and standards for all types of vehicles in the United States and Canada including:

- Motorcycles,
- Passenger Vehicles & Light Trucks,
- Salvage Vehicles,
- Trucks, Buses & Trailers, and
- Emissions.

Each handbook section contains information compiled from multiple sources and is based on actual working systems and programs in the United States and Canada.

To order additional handbook sections, use the order form provided with this manual or contact AAMVA (703-522-4200). In Canada, contact CCMTA (613-736-1003).

How To Use This Handbook

Designed for use by government officials, fleet operators, inspection managers and others who want to update or enhance existing procedures or develop new inspection programs, this handbook provides practical, up-to-date inspection procedures, and minimum recommendations and rejection criteria for passenger vehicles and light trucks. It also is intended to serve as a useful teaching tool for inspection training programs, and as a resource guide for maintenance programs.

Every effort has been made to provide specific inspection recommendations except where jurisdictions vary widely on what is acceptable, or where there is a broad range of acceptable conditions depending on the type of vehicle that is being inspected. In those instances, recommendations in this handbook rely on and refer to recognized industry specifications and limits, directly or indirectly, through the use of terms such as "properly," "adequate," "inadequate," "excessive," "perceptible," etc.

Differences between Canadian and United States minimum recommendations or procedures are clearly noted in the text by a maple leaf icon for Canada and a stars and stripes icon for the United States.

Also, please note that some jurisdictions may have more stringent requirements than the ones set forth in this handbook.

Based on Information from U.S. and Canadian Experts

This handbook is based on the *1995 Vehicle Inspection Handbook,* published by AAMVA, and was revised and expanded by members of AAMVA's Handbook Working Group, which is part of AAMVA's Engineering and Vehicle Inspection Committee. Information in the handbook also was reviewed and/or provided by representatives from CCMTA, American Automobile Manufacturers Association, National Highway Traffic Safety Administration, Federal Highway Administration, Specialty Equipment Market Association, Hunter Engineering, LET Corporation, Motorist Assurance Program, Association of International Automobile Manufacturers and the Automotive Manufacturers Equipment Compliance Agency.

Please note that the recommendations presented in this handbook reflect the majority view of the AAMVA Handbook Working Group, but every recommendation is not necessarily endorsed by each reviewer.

Handbook Reflects Experience and Cooperation

AAMVA has been involved in publishing vehicle inspection handbooks since the late 1980s, when AAMVA and the National Highway Traffic Safety Administration began working cooperatively to publish handbooks for passenger vehicles and trucks and buses with information provided primarily by the American Automobile Manufacturers Association.

In 1995, AAMVA published the first edition of the *Vehicle Inspection Handbook* for passenger vehicles. A year later, AAMVA's Engineering and Vehicle Inspection Committee began developing this expanded version of the handbook to provide inspection recommendations for all types of vehicles.

In 1997, CCMTA offered its manual, *Commercial Vehicle Inspections in Canada,* as the basis of the *Trucks, Buses & Trailers Inspection Handbook,* and AAMVA and CCMTA agreed to collaborate on the publication of the entire handbook set.

Because it includes recommendations for both the United States and Canada, the *Vehicle Inspection Handbook Set* is an important step toward the harmonization of standards in North America.

Jurisdictional Inspection Programs Improve Highway Safety

Billions of dollars are spent annually to design and construct highways that provide a safe environment for vehicular travel. Laws defining unacceptable conduct and conditions are enacted by legislators and enforced by employees of governmental entities, and minimum driver standards and requirements are developed for those applying for a driver's license. Yet, many jurisdictions leave to chance that people voluntarily will maintain the safety components of their motor vehicles.

To provide the optimal conditions for the safe operation of vehicles, all of the necessary elements of a highway safety program—the highway, the driver, and the vehicle—must work together.

By detecting defective vehicle parts before they fail, effective periodic motor vehicle inspection (PMVI) programs could prevent vehicle failure on the highways and prevent crashes that might result in injuries or death.

About half of the jurisdictions in the United States and seven Canadian provinces currently have PMVI programs that require the inspection of motor vehicles up to 10,000 lbs. (4,500 kg) Gross Vehicle Weight Rating (GVWR).

PMVI programs have become increasingly important as people keep vehicles for longer periods of time. As these vehicles age, they begin to wear out and become unsafe if they are not properly maintained. Motorists also are less aware of the mechanical condition of their vehicles today than in years past. With the elimination of full-service gas stations, most elementary preventive maintenance checks are ignored.

While roadside inspections by law enforcement officers serve to remove some unsafe motor vehicles from our highways, it is impractical to assume that this type of inspection has a significant impact on highway safety. Such inspections are limited by the number of officers available to perform inspections, the individual officer's competence to conduct such inspections, and the equipment available to perform the inspection. No jurisdiction has a sufficient number of law enforcement officers to ensure that even a small percentage of the vehicles traveling within that jurisdiction can and will be inspected within any given time period.

On the other hand, periodic inspections serve to verify the integrity of the vehicle's critical safety components that are necessary to ensure that the vehicle is in safe operating condition.

Recommendations for Jurisdictional Programs

Based on the experience of existing inspection programs, jurisdictions that are establishing or updating a vehicle inspection program are encouraged to:

- Review and improve established programs for their effectiveness in locating defective components or unsafe conditions that could cause or contribute to motor vehicle accidents.

- Inspect registered vehicles at least once every 12 months. Inspection prior to sale or at the time ownership is changed is less than adequate; however, inspections conducted at these times, in addition to a regular PMVI program, would provide the most effective inspection program.

- Check for agreement among the registration certificate, license plate, vehicle description, insurance data (if required) and vehicle identification number (VIN). Also check the VIN to ensure that it has not been altered or defaced, and that the VIN on the dash agrees

with the VIN on the door or bulkhead. This will help identify stolen vehicles and deter vehicle fraud.

- Inspect the license plate mounting and condition for evidence of tampering and to ensure that the plate is not obscured, illegible or mounted insecurely.

- Request and check for a valid driver's license, endorsement or learner's permit. If the operator does not have valid documents, the vehicle should be impounded until the operator or the owner produces a valid document. **Note:** This procedure should be conducted only by an official with law enforcement authority.

- Require that a minimum of one wheel be removed from each axle during the inspection process and provide for dynamic testing of braking components whenever practical.

- Clearly state pass/fail standards and review those standards periodically for compatibility with existing vehicle technology.

- Merge the Emissions Inspection and Maintenance (I/M) programs into PMVI programs and provide both inspections at the same time at the same location. Merging these programs reduces overall administrative operating costs and provides faster and easier public access to inspections. Even when two separate agencies are responsible for the PMVI and I/M programs, cost savings to the agencies and to the public can be realized through consolidation.

- Distribute vehicle registrations over a 12-month period so that all registrations and inspections do not become due at the same time. This enables vehicle owners to have both the PMVI and the I/M inspections performed prior to their vehicle registration period, and it enables owners to comply with the emissions inspection and vehicle registration tie-in.

- Develop uniformity in the inspection process among the stations performing inspections. This is essential to ensuring the effectiveness of the program and maintaining the credibility of the program.

- Seek legislation that will provide for greater PMVI reciprocity with other jurisdictions that have equivalent PMVI programs.

Frequency of Wheel Removal for Brake Inspection

Combining wheel removal with dynamic testing is the optimal brake inspection procedure. It verifies the actual condition of the braking components and the proper functioning of the entire braking system.

While dynamic brake testing provides information about the operating efficiency of braking systems, such testing does not indicate the depth of wear or disclose the actual physical condition of the braking components.

Although the removal of all four wheels on a vehicle will provide the best inspection, time and cost factors may preclude these requirements during the inspection process. Requiring the removal of one wheel on each axle of a motor vehicle is considered practical and effective.

Jurisdictions that require the removal of wheels for brake inspection report that the number of vehicles rejected for faulty braking has risen dramatically. In many cases, those defects were found on vehicles that would not have been repaired until a failure occurred. Detection of worn braking components before a failure occurs reduces the probability of the vehicle becoming involved in a crash and the repair costs.

Some jurisdictions do not require this type of brake inspection because of liability considerations and the time involved. However, those jurisdictions that do mandate wheel removal indicate that they have not experienced liability problems.

Also, in decentralized programs, the additional time necessary to conduct the inspection has not proven to be an overwhelming obstacle, and the results have more than offset the few additional minutes required.

Recommended Frequency of Inspection

Inspecting motor vehicles at least once every six months provides optimal safety results. However, most PMVI jurisdictions have found that mandatory vehicle inspection every six months overburdens inspection facilities and personnel, creates some negative public reaction and is not politically acceptable.

Thus, while more frequent inspection is desirable, jurisdictions should require every motor vehicle to undergo an inspection of its safety components at least once every 12 months.

Compliance and Enforcement

Most PMVI jurisdictions use the inspection sticker concept to identify vehicles that have passed safety inspection standards. Such programs are effective and law enforcement officials can easily identify vehicles that are not in compliance. Registration tie-in also would deter the theft and counterfeiting problems experienced by some jurisdictions.

Recommended Minimum Inspection Items

1. Brake System
- A. Functional Brake Inspection/ Performance Test
  - 1. Performance Test
    - a. Imbalance
    - b. Stopping Capability
  - 2. Component Inspection
    - a. Hoses, Lines and Fittings
    - b. Master Cylinder
    - c. Pedal Pressure
    - d. Brake Warning Light
    - e. Power Booster
    - f. Parking Brake
    - g. Mechanical Parts
- B. Component Brake Inspection with Removal of Wheel(s) and Drum(s)
  1. Wheel Bearings
  2. Caliper/Wheel Cylinder
  3. Drums/Rotors
  4. Linings/Disc Pad
  5. Hoses, Lines and Fittings
  6. Master Cylinder
  7. Pedal Pressure
  8. Brake Warning Light
  9. Power Booster
  10. Parking Brake
  11. Mechanical Parts

2. Wheel System
- A. Tires
- B. Wheels

3. Suspension and Steering System
- A. Wheel Bearings
- B. Ball Joints/King Pin
- C. Manual and/or Power Assist Mechanism
- D. Linkage
- E. Stabilizers
- F. Steering Wheel/Column
- G. Wheel Alignment
- H. Shock Absorbers/Struts
- I. Springs/Torsion Bars
- J. Bumper Height

4. Fuel System
- A. Storage
- B. Supply
- C. Distribution
- D. Fire Suppression

5. Exhaust System: From manifold to tailpipe inclusive.

6. Lighting and Signal System
- A. Headlamps
- B. Hazard Warning Lamps
- C. Stop Lamps
- D. Tail Lamps
- E. Turn Signal Lamps
- F. License Plate Lamp(s)
- G. Clearance/Side Marker Lamps
- H. Reflectors
- I. Horn

7. Electrical System
- A. Switches
- B. Wiring
- C. Connections
- D. Transmission

8. Glazing and Visibility
- A. Windshield
- B. Side and Rear Windows
- C. Rearview Mirrors
- D. Defroster/Defogger
- E. Wiper and Washer

9. Body Components
- A. Doors
- B. Floor
- C. Seat(s)
- D. Front Hood Latch
- E. Safety Belts
- F. Bumper(s)
- G. Fender(s)

10. Emission Control Components
- A. Air Injection System
- B. Catalytic Converter
- C. Exhaust Gas Recirculation System
- D. Fuel Fill Pipe Restrictor
- E. Thermal Reactor
- F. Positive Crankcase Ventilation Valve
- G. Evaporative Canister

CHAPTER 1

Brakes

(Diagnostic Equipment/Wheel Removal)

1. Service Brake Road Tests

Road tests, using either a decelerometer or stopping distance measurements, should be done on level, dry, hard, smooth pavement, free from oil, grease or loose dirt. Tires should be of matching construction and be properly inflated. (See Chapter 2.)

A. STOPPING DISTANCE METHOD

Equipment needed: Measuring tape or pre-marked lane.

Procedure

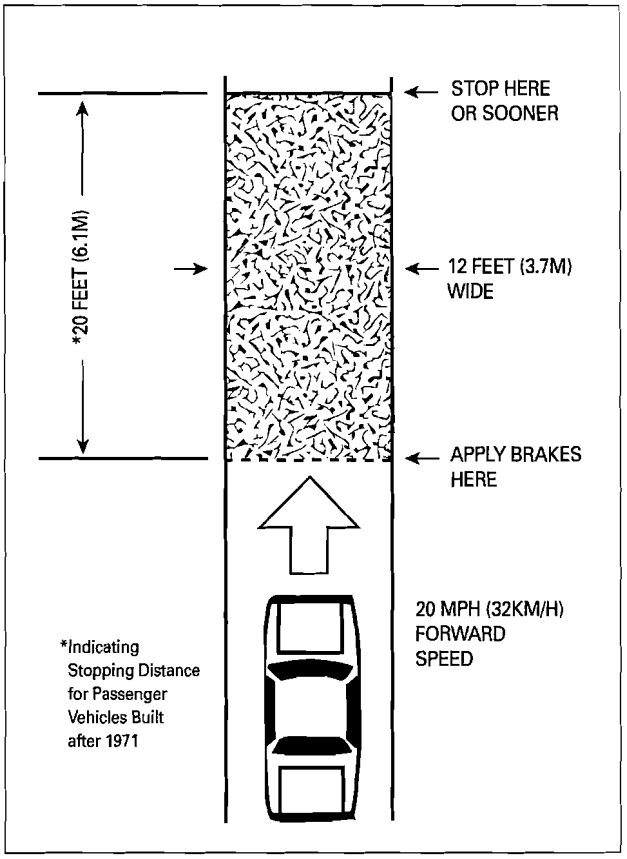
At a speed of 20 mph (32 km/h), apply the service brake firmly, without causing the wheels to lockup. Observe if the vehicle comes to a smooth stop within the distance prescribed by any applicable law(s) without pulling to the right or left beyond the limits.

Reject the vehicle if:

- It swerves enough for any part to leave a 12-foot lane.
- It fails to stop within the required distance, usually:

  25 feet (7.5 m)
  - vehicles built 1971 or earlier
  - all light trucks and multi-purpose vehicles.

  20 feet (6.1 m)
  - vehicles built 1972 or later



Road Test—Stopping Distance Method

B. DECELERATION METHOD

Equipment needed: Decelerometer, either U-tube or pendulum type.

Procedure

Step 1: Mount the decelerometer at the center line of the vehicle and level the instrument.

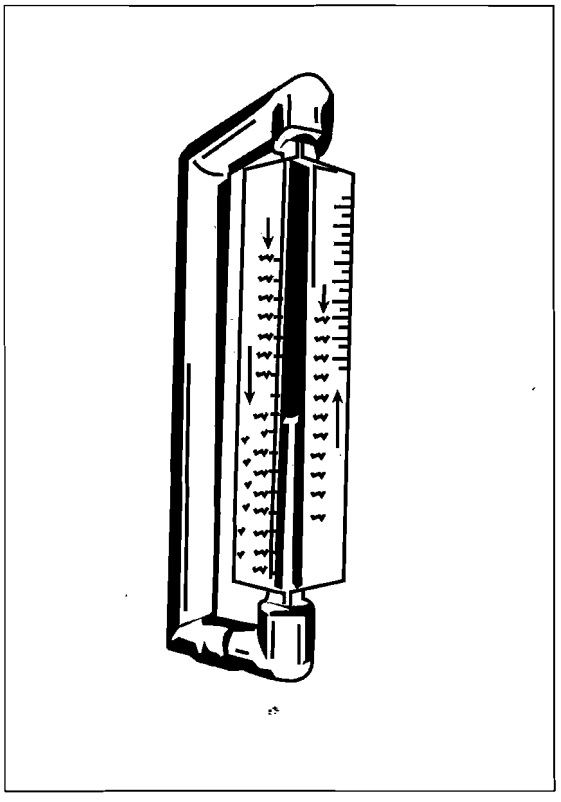
Step 2: Drive the vehicle forward at a speed of 20 mph (32 km/h) and apply the service brake.

Step 3: Observe the decelerometer reading and whether the vehicle pulls to the right or left.

Reject the vehicle if:

- It swerves enough for any part to leave a 12-foot lane.
- A decelerometer reading of at least 21 feet (6.4 m) per second per second (psps) cannot be achieved, or a reading of 17 feet (5.2 m) psps cannot be achieved on vehicles built before 1972.

  Note: Decelerometers for measuring brake system application and braking distance are not the same as inertia-type decelerometers and other existing brake testers that do not measure vehicle stopping distance.



Deceleration "U-Tube"

The pendulum and U-tube decelerometers used for brake testing are scaled to read deceleration or an equivalent braking force (sometimes referred to as brake efficiency) in percentages. The principle of the pendulum-type decelerometer is that a pendulum on a vehicle moving at uniform speed will assume a vertical position. When the vehicle speed is reduced as the brake is applied, the pendulum will swing forward to an angle away from the vertical. The tangent of the angle through which the pendulum moves is directly proportional to the deceleration.

The U-tube fluid-type instrument is a closed glass tube formed in the shape of a U. When the vehicle speed is reduced by braking, the inertia of the fluid causes the level in the glass tube to change. The distance the level of the liquid changes is proportional to the deceleration in feet psps, which is read from a scale on the tube.

The vehicle normally will pitch because the lines of action of the inertia and braking force are different. To minimize inaccurate responses, the decelerometer should be put as close to the center of the vehicle as is practical.

2. Service Brake Station Tests

Some inspection stations are equipped with either a platform testing machine or a roller-type brake dynamometer, or both. The platform testing machine will indicate the relative effectiveness of each wheel (i.e. braking balance), while the roller indicates both braking effort and balance. Both machines require training and skill on the part of the operator and periodic maintenance and calibration. Certain models of platform testing machines are not generally sensitive enough to read the rear axle effort of front-wheel-drive vehicles.

A. DYNAMOMETER METHOD

Equipment needed: Roller-type brake dynamometer with instrumentation.

Procedure

Step 1: Make sure the tires are inflated to the recommended values.

Step 2: Position the vehicle on the rollers and begin testing. Follow the recommended testing procedures of the dynamometer manufacturer.

Reject the vehicle if:

- It does not meet the manufacturer's specifications.

  Note: When some front-wheel drive cars, multi-purpose vehicles and light duty trucks, are tested on the roller-type brake testing machine, the rear axle brake force may measure lower than expected. Such readings are characteristic of the brake system design and performance, and should not be considered criteria for rejection of the vehicles.

Additional Information

For vehicles other than passenger vehicles or light trucks, the effectiveness of this type of brake tester, which measures braking force at each wheel, is very questionable.

Additionally, some vehicles equipped with four wheel-disc brakes or vehicles with front-wheel-drive may cause the tester to indicate an unbalanced condition when in fact, the total system is performing safely and properly.

B. PLATFORM TESTER METHOD

Equipment needed: Drive-on-and-stop platform tester.

Procedure

Step 1: Make sure the tire pressure is at the recommended levels, tire wear is even at all four wheels and all tires are of the same construction type.

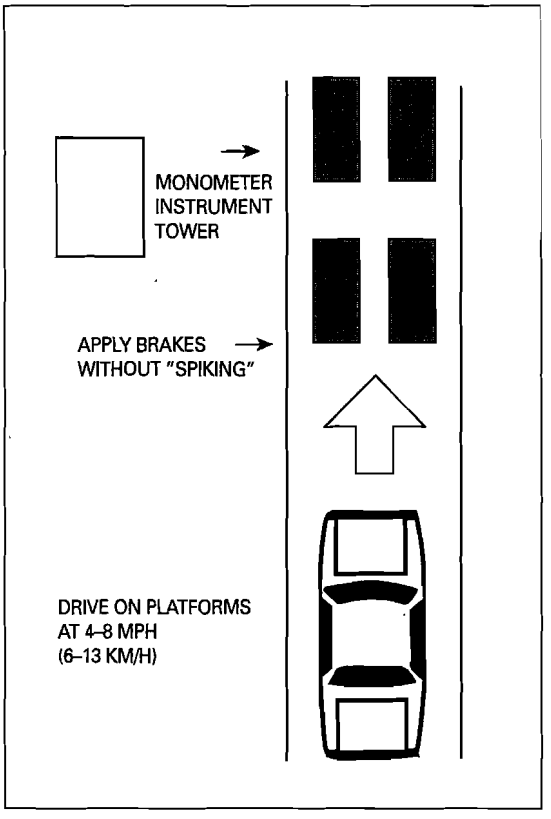
Step 2: On vehicles with automatic transmissions, inspectors should familiarize themselves with the location of "Drive" and "Neutral" in the shift pattern.

Step 3: Drive the vehicle onto the platform tester and shift the transmission to "Neutral," at a speed of 4 to 8 mph (6-13 km/h).

Step 4: When all the wheels are on the platform, apply the brakes firmly without wheel lockup.

Reject the vehicle if:

- Any wheel fails to indicate braking action.
- The brake balance does not comply with the following, "Recommended Pass/Fail Specifications," for the type of platform used.



Platform Tester

Recommended Specifications for Mechanical/Manometer Testers

LEFT/RIGHT RATIO	MAXIMUM VARIANCE
Front Axle	25%
Rear Axle	35%

(In other words, if the brake force on one wheel of a front axle is less than 75% of the force on the other wheel.)

Recommended Specifications for Computer/Load Cell Testers without Ideal Axle Bias Computation/Estimation

DECELERATION	MINIMUM	MAXIMUM
	50%	95%
LEFT/RIGHT RATIO		
Front Axle		25%
Rear Axle		35%
FRONT/REAR RATIO	MINIMUM	MAXIMUM
Absolute	50%	95%

Recommended Specifications for Computer/Load Cell Testers with Ideal Axle Bias Computation/Estimation

DECELERATION	MINIMUM	MAXIMUM
	50%	95%
LEFT/RIGHT RATIO		
Front Axle		25%
Rear Axle		35%
FRONT/REAR RATIO	MINIMUM	MAXIMUM
Absolute	40%	95%
Front Bias		Ideal + 25%
Rear Bias		Ideal – 15%

Additional Information

- For vehicles designed with strong front-biased brakes, there may be little rear braking indicated on a computerized platform tester or no rear braking indicated on a mechanical platform tester. If a failed result is indicated for too little brake force at the rear, the following procedure is recommended: Jack up the rear of the vehicle and apply the brake pedal to determine if the rear brakes can be applied hard enough to hold against the inspector's effort to rotate the wheel. If the wheel rotates, the vehicle should be rejected.
- Some multi-use vehicles, such as pickups and vans over 7,000 lbs. (3182 kg) GVWR may be designed with strong rear-biased brakes for adequate braking when fully loaded. If a failed result is indicated when tested with a light load on a computerized platform tester, the following procedure is recommended: Perform the stopping distance test as previously described in this chapter. If the rear wheels lock prematurely causing the rear to slide sideways, reject the vehicle.

3. Hydraulic Systems

If the wheels are removed during the brake inspection, removal of all four wheels is recommended. Always remove the wheels if there is evidence of grease, oil or hydraulic brake fluid on any wheel or tire. Inspect the following components if they are included on the type of braking system installed in the vehicle.

Caution: If the wheels are removed, do not disturb the dust boot. Also, never allow dirt to mix with the fluid in the brake reservoir.

Equipment needed: Force gauge calibrated in pounds.

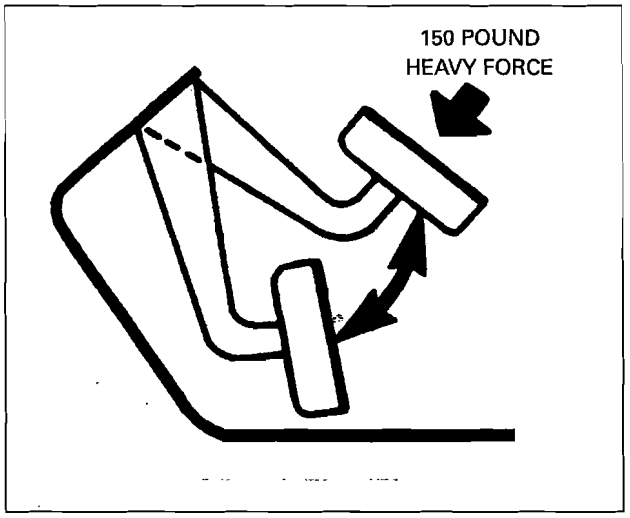
A. PEDAL RESERVE

Procedure

On vehicles with power brakes, while the vehicle is stopped and the engine is running, apply a moderate (50-lb.) force to the brake pedal.

Reject the vehicle if:

- The brake warning light illuminates, or the brake pedal falls away under pressure and/or comes in contact with some object that prohibits brake pedal movement.



Pedal Travel

Note: On most passenger vehicles, the brake warning light will illuminate to indicate when the parking brake is applied. If the brake light illuminates during the brake inspection, make sure that the parking brake has not been applied.

B. HYDRAULIC LEAKS

Procedure

On vehicles with power brakes, while the vehicle is stopped and the engine is running, apply a heavy (150 lb.) force to the brake pedal and hold it for a minimum of 10 seconds. Observe if the pedal moves slowly downward.

Reject the vehicle if:

- The pedal height cannot be maintained for 10 seconds or the brake failure light illuminates.

C. MASTER CYLINDER

Procedure

Step 1: Thoroughly clean the master cylinder area and look for leaks.

Step 2: Remove the cover and check the fluid level by observing the fluid level through the opaque reservoir or by removing the cover. Be sure that the cover gasket is serviceable and that no dirt gets in the reservoir when the cover is removed.

Reject the vehicle if:

- The master cylinder leaks.
- The fluid level is below the minimum level indicated by the manufacturer on the reservoir.
- The gasket is torn, damaged or swollen. A swollen gasket may indicate oil in the system.

  Note: Low fluid in the master cylinder reservoir chambers may be due to normal wear of the front and/or rear linings. Simply requiring the reservoir to be full may mask a real problem.

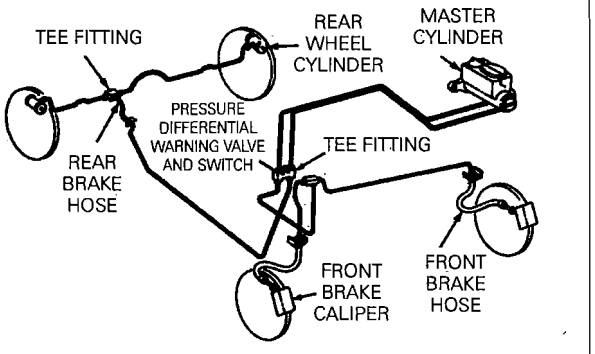
D. HYDRAULIC HOSES AND/OR LINES

Procedure

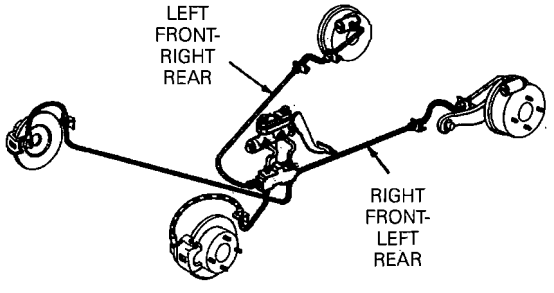
Visually inspect the hydraulic hoses and/or lines.

Reject the vehicle if:

- The hoses and/or lines have leaks, cracks or blistered areas.
- The hoses and lines are chafing, flattened, have restricted sections, or are not properly secured in place.
- Repairs have not been made with steel tubing. Note: The use of copper lines in a hydraulic system as a substitute for steel brake lines is not permitted. Also, flexible brake hoses should not be installed with more than a 15 degree twist.



TYPICAL FRONT/REAR BRAKE SYSTEM



TYPICAL DIAGONAL BRAKE SYSTEM

Typical Brake Hydraulic Systems Brake Tubes and Hoses

E. WHEEL CYLINDER—DRUM BRAKE.

Procedure

Remove the drum and check the wheel cylinder for leakage and damaged, loose or missing parts. Also make sure that it is properly secured in place.

Caution: Make sure that lug nuts are properly torqued when reinstalling the wheels after inspection.

Reject the vehicle if:

- Fluid is leaking from the cylinder or if parts are damaged, loose, missing or improperly retained.

  Note: DO NOT PRY UNDER OR OTHERWISE DISTURB THE DUST BOOT. This will destroy a seal that may soon result in wheel cylinder damage. If the wheel cylinder is leaking, the fluid will find its way around the dust boot.

F. CALIPER—DISC BRAKE ASSEMBLY

Procedure

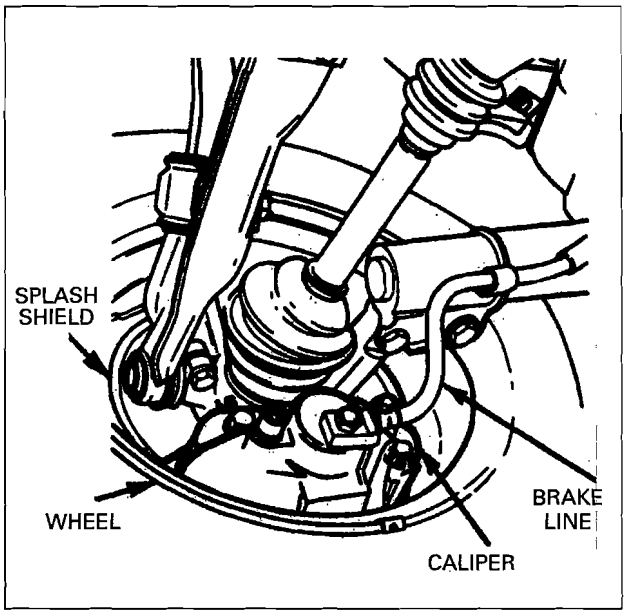
If the system has a caliper assembly, inspect for leakage, missing parts and retention.

Reject the vehicle if:

- Fluid is leaking from the caliper assembly, parts are missing, damaged or improperly retained.

G. DRUMS AND DISCS

Many modern passenger vehicles have a combination of disc (caliper) brakes on front wheels and drum brakes on the rear wheels. The maximum allowable drum diameters and minimum allowable disc thickness measurements are marked on the drum or disc for all vehicles built since 1971 and on some vehicles built prior to 1971.



Disc Brake Assembly Front-Wheel Drive

Procedure

Step 1: Check the brake discs (rotors) for mechanical damage and cracks extending to the edges.

Reject the vehicle if:

- The disc is broken or has cracks on the friction surface extending to the open edge.

Step 2: Measure the thickness of the disc.

Equipment needed: Micrometer.

Reject the vehicle if:

- The disc thickness is equal to or less than the minimum specification marked on the disc assembly.

  Note: When turning a disc brake, the drag is not excessive if the brake can readily be turned with both hands. Do not distort the splash shield while measuring the disc.

H. BRAKE DRUMS

Procedure

Step 1: Check the friction surface for cracks extending to the open edge of the brake drums.

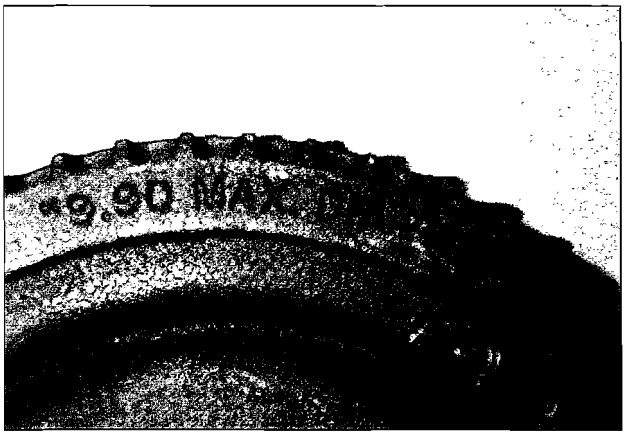
Step 2: Inspect for mechanical damage and contamination of the friction surface.

Reject the vehicle if:

- The drum has cracks on the friction surface extending to the open edge or on the outside of the drum, particularly at the drum mounting area.
- There is evidence of mechanical damage other than wear, or if the friction surface is contaminated with grease, oil or brake fluid.
- The mounting holes are elongated.

Advise the driver if:

- Hard spots appear on the drums. This can cause chatter from uneven friction, and the drums should be machined or replaced.



Courtesy of Midas International Corporation

Drum Diameter Marking

Step 3: Measure the inside diameter of the brake drum.

Equipment needed: Drum measuring gauge.

Reject the vehicle if:

- Any combination of brake drum machining and/or wear exceeds the manufacturer's limit.
- The manufacturer's limit is not given and any combination of wear and/or machining exceeds the original diameter by more than the following limits:

ORIGINAL DIAMETER	LIMIT
All passenger cars	1.5 mm (0.060 inch)
360 mm (14 –1/8 inch) or greater	2.3 mm (0.090 inch)

4. Linings, Pads and Mechanical Components

If wheels are removed for inspection, it is recommended that all four wheels and any drum assemblies be removed. Since some vehicles are now diagonally split, and some are split front to rear, it is impossible to be sure if the brakes have the same wear without looking at each wheel. It is much more common today to find one front or one rear brake worn before the other on the same axle than it was in years past.

A. CONDITION OF MECHANICAL COMPONENTS

Procedure

Step 1: Depress and release the brake pedal to check for normal functioning.

Step 2: Inspect the pedal shaft and bushings for high friction, wear and misalignment.

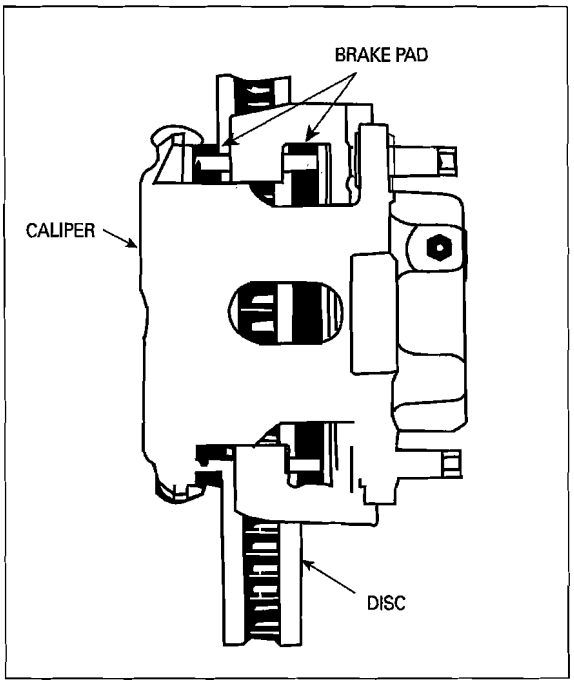
Step 3: Ensure that the brake pedal to master cylinder booster push rod retaining device is in place and secure.

Step 4: Look for worn pins and missing or defective cotter pins, broken or missing springs, worn cables, clevises, couplings, rods, and anchor pins.

Step 5: Inspect for a frozen, rusted or inoperative adjuster screw or connections, missing spring clips, and defective grease retainers. Look for restricted shoe movement at the backing plate and for bind between shoes and anchor pins. The automatic adjuster mechanism must be free.

Reject the vehicle if:

- Mechanical parts are missing, broken, binding or badly worn.
- There is excessive friction in the pedal, linkage or components.
- The pedal levers are misaligned or improperly positioned.



Typical Disc Brake

B. BRAKE LINING AND PAD WEAR

Procedure

Inspect the brake lining and pad for excessive wear.

Equipment needed: Measuring device, steel scale or gauge.

Reject the vehicle if:

- Bonded linings are less than 2/32 of an inch (1.6 mm) as measured at the thinnest point.
- Riveted linings are less than 2/32 of an inch (1.6 mm) above the rivet head at the thinnest point.
- The mechanical wear sensor (if so equipped) is contacting the drum or rotor.
- The electronic wear sensor light is on (if so equipped).

  Note: The light may need to be reset.
- The brake lining is broken, not firmly attached to the drum shoe or pad plate (the backing on disc pads), contaminated with oil or grease, or if the wear is extremely uneven.

5. Hydraulic and Vacuum Boosters

Note: Some vehicles, beginning with the 1976 models, have a hydraulic power system that serves both the power assisted brakes and power assisted steering systems. Some vehicles, beginning with the 1985 models, have an integrated hydraulic actuation and anti-lock brake unit that uses only brake fluid.

A. HYDRAULIC SYSTEM OPERATION

Note: This section does not pertain to vacuum-assisted boosters.

Procedure

Step 1: Turn off the engine.

Step 2: Depress the brake pedal several times to eliminate all pressure.

Step 3: While holding the brake pedal down with a light foot force (25 lbs.), start the engine and observe if the pedal moves slightly upward when the engine starts.

Note: A hydro-booster using power steering will come up slightly.

Reject the vehicle if:

- The pedal does not move upward slightly as the engine is started while the inspector applies the brake with a light foot force.

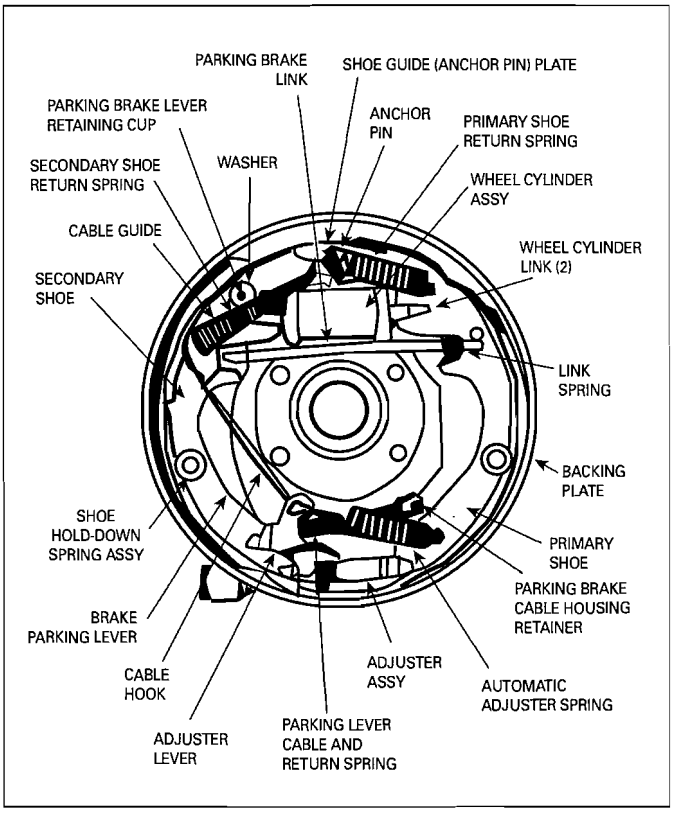
B. HYDRAULIC BOOSTER POWER BRAKE SYSTEM

Procedure

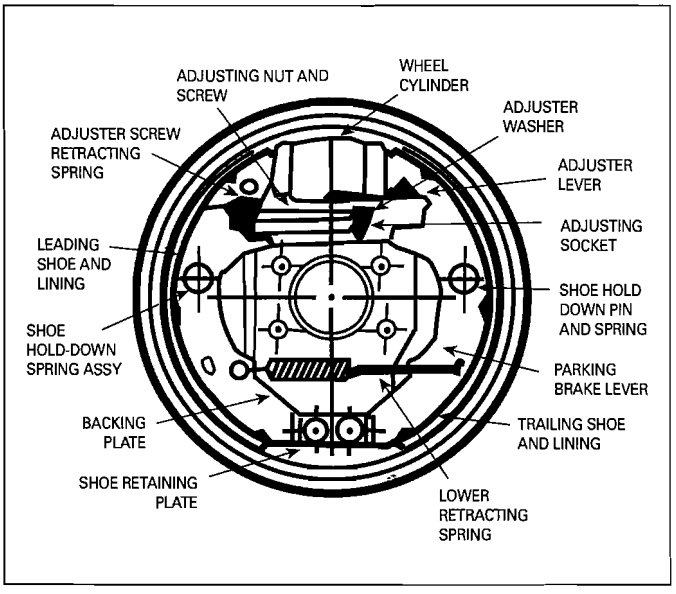
Inspect the system for fluid level and leaks.

Reject the vehicle if:

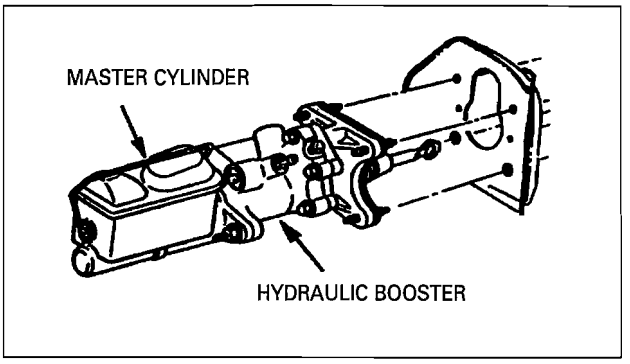
- There is insufficient fluid in the pump reservoir.
- There are broken, kinked or restricted fluid lines or hoses.



Typical Servo Drum Brake



Typical Non-Servo Drum Brake



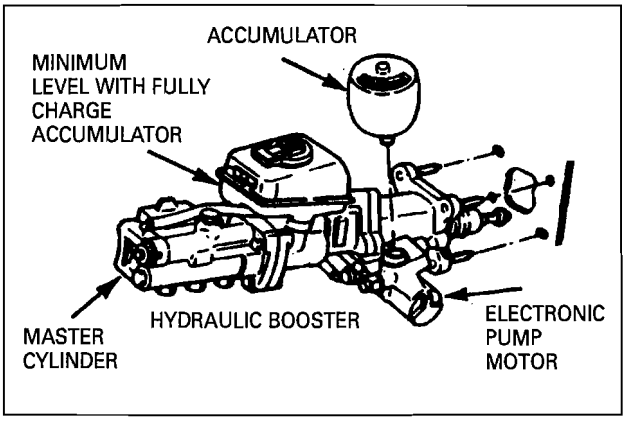
Typical Hydraulic Booster Assembly

- There is any leakage of fluid at the pump, brake booster, or in any of the lines or hoses in the system.
- Belts are frayed, cracked or excessively worn.

C. INTEGRATED HYDRAULIC BOOSTER/ ANTI-LOCK SYSTEM OPERATION

Procedure

Step 1: With the ignition key in the "OFF" position, depress the brake pedal a minimum of 25 times (50 times on jeeps with anti-lock brakes) to deplete all residual stored pressure in the accumulator. Depress the pedal with a light foot force (25 lbs).



Typical Integrated Hydraulic Booster Anti-lock System

Step 2: Place the ignition key in the "ON" position and allow 60 seconds for the brake and anti-lock warning lights to go out, indicating that the accumulator has fully charged.

Reject the vehicle if:

- The brake pedal does not move down slightly as the pump builds pressure.
- The brake and anti-lock warning lights remain on longer than 60 seconds.

D. INTEGRATED HYDRAULIC BOOSTER/ ANTI-LOCK SYSTEM

Procedure

With the system fully charged, inspect for fluid level and leaks.

Reject the vehicle if:

- There is insufficient fluid in the reservoir.
- There are broken, kinked or restricted fluid lines or hoses.
- There is any leakage of fluid at the pump or brake booster, or in any of the lines or hoses in the system.

6. Vacuum System Operation

A. PEDAL PRESSURE

Procedure

Step 1: Turn off the engine, then depress the brake pedal several times to eliminate all vacuum in the system.

Step 2: Depress the brake pedal with a light foot force (25 lbs).

Step 3: While maintaining this force on the pedal, start the engine and observe if the pedal moves down slightly when the engine starts.

Reject the vehicle if:

- The pedal does not move down slightly as the engine is started while force is applied to the brake pedal.

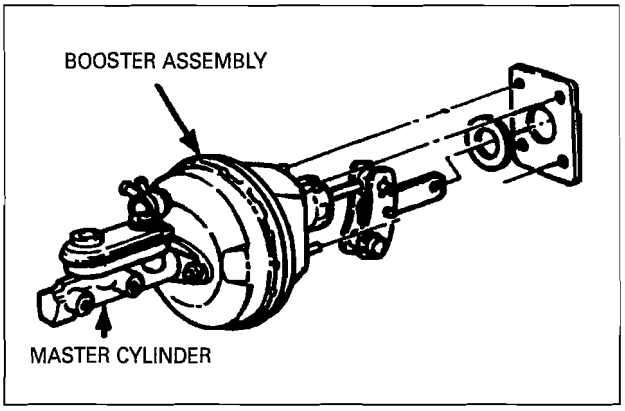
B. VACUUM BOOSTER POWER BRAKE SYSTEM

Procedure

Visually inspect the condition of the vacuum booster power brake system.

Reject the vehicle if:

- There are collapsed, cracked, broken, badly chafed or improperly supported hoses and tubes, or loose or broken hose clamps.



Typical Vacuum Booster Assembly

7. Parking Brake

The parking brake system is a brake system used to hold and maintain a vehicle in a stationary position when the vehicle is unattended.

A. PARKING BRAKE OPERATIONS

Procedure

Step 1: Inspect the "SET" and "RELEASE" functions of the parking brake. With the vehicle transmission in neutral, set the parking brake firmly in accordance with the manufacturer's recommendations.

Step 2: With the engine on, place the shift lever in the "DRIVE" position for vehicles with automatic transmissions and in low gear with the clutch engaged for vehicles with standard shift transmissions.

Step 3: With the parking brake set, release the service brake pedal and accelerate slightly.

Note: Some vehicles automatically release the parking brake when the vehicle is shifted from the "PARK" position. On these vehicles, maintain foot pressure on the parking brake pedal during the operational test.

Reject the vehicle if:

- The parking brake will not hold the vehicle stationary with the engine running at a slightly accelerated speed.

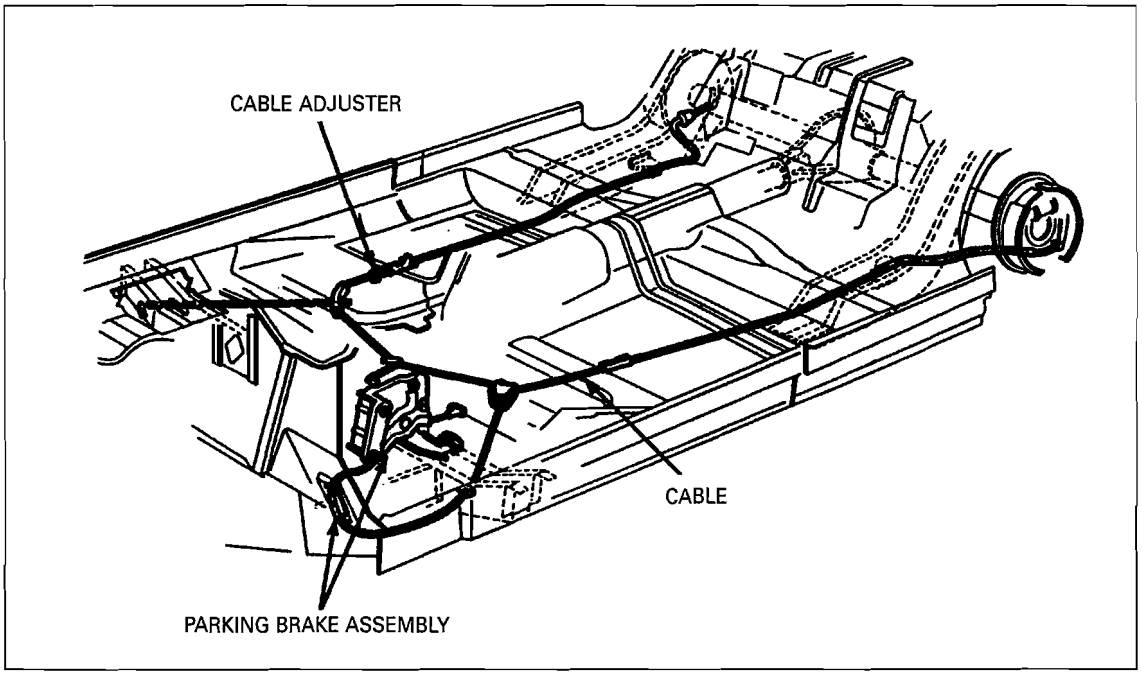
B. CONDITION OF MECHANICAL COMPONENTS

Procedure

Inspect for worn pins, missing or defective cotter pins, broken or missing springs, worn or seized cables, clevises, couplings, rods, and anchor pins.

Reject the vehicle if:

- Mechanical parts are missing, seized, broken or badly worn.



A Parking Brake System

C. BRAKE FAILURE WARNING LIGHT

Procedure

Step 1: Apply the brake and turn the ignition to the "ON" position.

Step 2: Start the engine. The warning light should illuminate in the "ON" or "START" position.

Step 3: Release the parking brake. The warning light should turn off unless it is an anti-lock brake system and the hydraulic pump has not reached its minimum pressure.

Reject the vehicle if:

- The brake system failure indicator light or warning light does not illuminate.
- The brake system failure indicator light or warning light remains illuminated after the engine is started and the parking brake is released, except for anti-lock systems (see Hydraulic Boosters).

  Note: Some imported vehicles use a press-to-test indicator as a brake warning light. The procedure for testing this brake warning light is to press the light itself, which serves as a button. It will illuminate when pressed.

Tires & Wheels

It is suggested that:

- Radial ply tires should not be used with tires of different construction such as bias or belted tires.
- Tires of a different size or type, such as one snow tire and one regular tire, should not be used on the same axle.

1. Tire Pressure

Procedure

Measure the tire pressure.

Equipment needed: Pressure gauge.

Advise the driver if:

- The tire pressure, including the spare tire (if so equipped), is significantly above or below the recommended inflation pressure. If the pressure is not within acceptable standards, determine if the owner wants to correct the pressure before continuing with the inspection. If the pressure is not corrected, the vehicle could possibly be rejected later in the inspection.

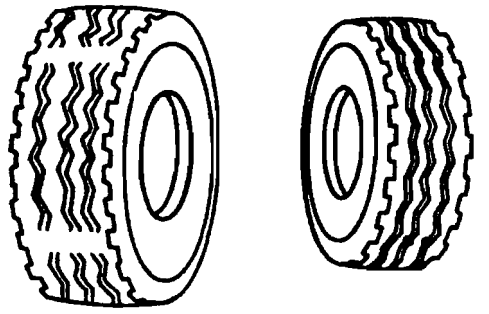
2. Tire Condition and Wear

Procedure

Step 1: Inspect for tire damage.

Reject the vehicle if:

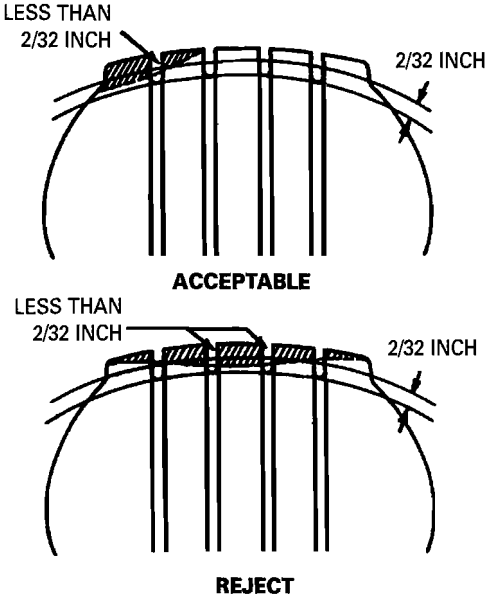
- Any tire has tread cuts, snags or sidewall cracks in excess of one inch (25 mm) in any direction and deep enough to expose cords.



Any tire worn to the level of the tread wear indicators in any two or more adjacent tread grooves or when cord fabric is exposed.

Any tire worn to the point where less than 1/16 inch (1.6 mm) of tread design depth remains in any two or more adjacent major tread grooves, exclusive of tie bars or when cord or fabric is exposed.

TIRE WEAR



Tire Tread Depth

- Any tire has visible bumps, bulges (not including rippling caused by sidewall ply splice undulation), or knots indicating partial failure or separation of the tire structure.

Step 2: Inspect for cord exposure.

Reject the vehicle if:

- Any tire is worn so that the cord is exposed through the tread.

Step 3: Inspect for tire wear using tread wear indicators or a measuring gauge.

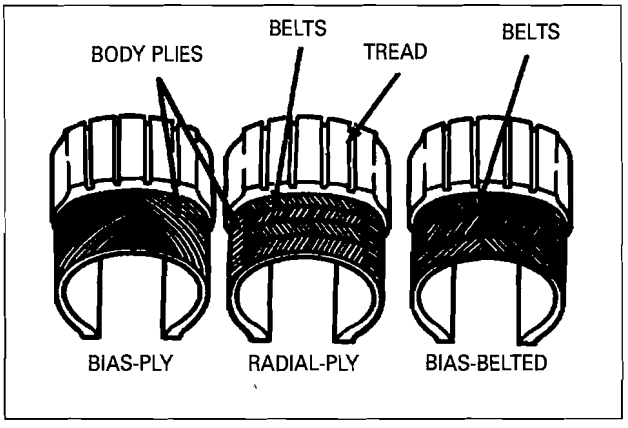
Reject the vehicle if:

- A tire with tread wear indicators is worn so that the tread wear indicators on the tire contact the road in any two or more adjacent grooves at three or more locations evenly spaced around the outside of the tire.
- A tire is worn so that less than 2/32 of an inch (1.6 mm) tread remains when measured in two or more adjacent major grooves at three or more locations evenly spaced around the outside of the tire.

Step 4: Inspect for regrooved or recut tires.

Reject the vehicle if:

- A tire has been regrooved or recut below the original groove depth, except special tires that have undertread rubber for this purpose and can be identified as such.



Tire Construction Diagram

3. Tire Size and Type

Procedure

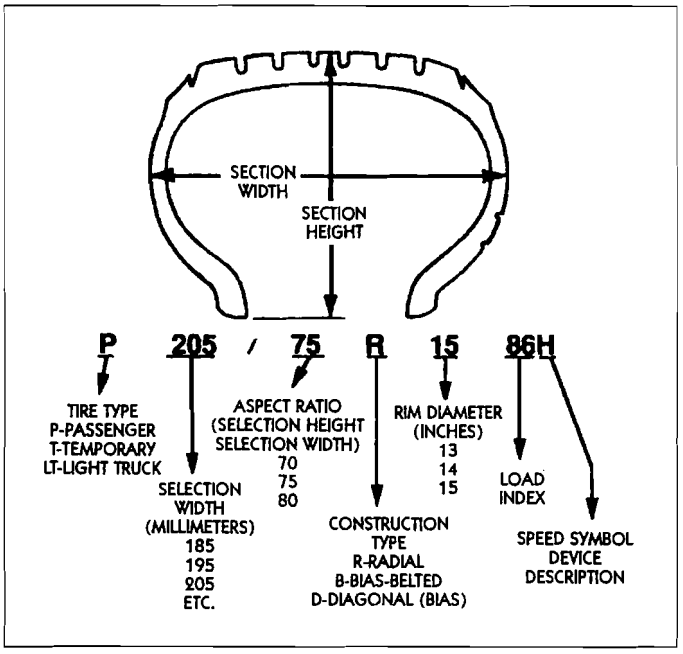
Inspect for tire size or mismatching.

Notes

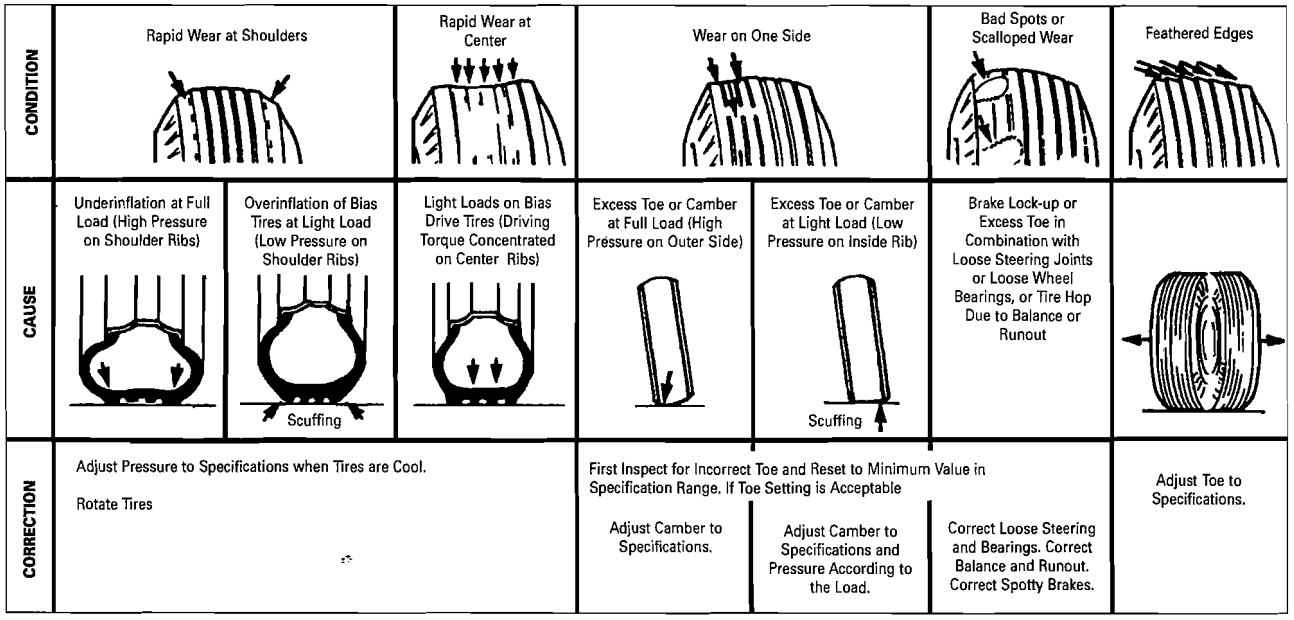
- As a general rule, do not mix different size tires on the same axle. It may be permissible to mount tires having different size nomenclatures (U.S. standard-metric) on the same axle when construction, dimensions and load capacity are compatible. Consult the tire manufacturer for specific permissible use.
- Tire/wheel size difference because of the existence of an original equipment temporary spare or equivalent, should not be considered grounds for rejection.

Reject the vehicle if:

- Tires on the same axle are not the same type of construction.
- Tires protrude past the fenders.
- The tire is marked for farm use only, off-highway use only, or for racing only, etc.



Metric Tire Size Diagram



Tire Wear Patterns

4. Wheels and Valve Stem

Procedure:

Step 1: Inspect the wheels (rims).

Reject the vehicle if:

- Wheel bolts, nuts, studs or lugs are loose, missing or damaged.
- Any part of the wheel is bent, cracked, rewelded, damaged or has elongated bolt holes, so as to affect the safe operation of the vehicle.
- Wheels on the same axle have different rim diameters or widths.

Step 2: Inspect the valve stem.

Reject the vehicle if:

- The valve stem is cracked or chafed from contact with the rim.
- The valve stem is not accessible for measuring the tire pressure.

Suspension & Steering

Lifting techniques vary for measuring wheel bearing movement. On vehicles with coil spring or torsion bar on the lower support arm, hoist at the frame. On vehicles with coil spring and upper support arm, hoist at the lower support arm. On front-wheel drive vehicles, the inspector must consult the manufacturer's lifting information.

Equipment needed: Floor jack or hoist and rule or gauge.

1. Wheel Bearing Movement

Front wheel bearings on rear-wheel drive vehicles, or rear wheel bearings on front-wheel drive vehicles.

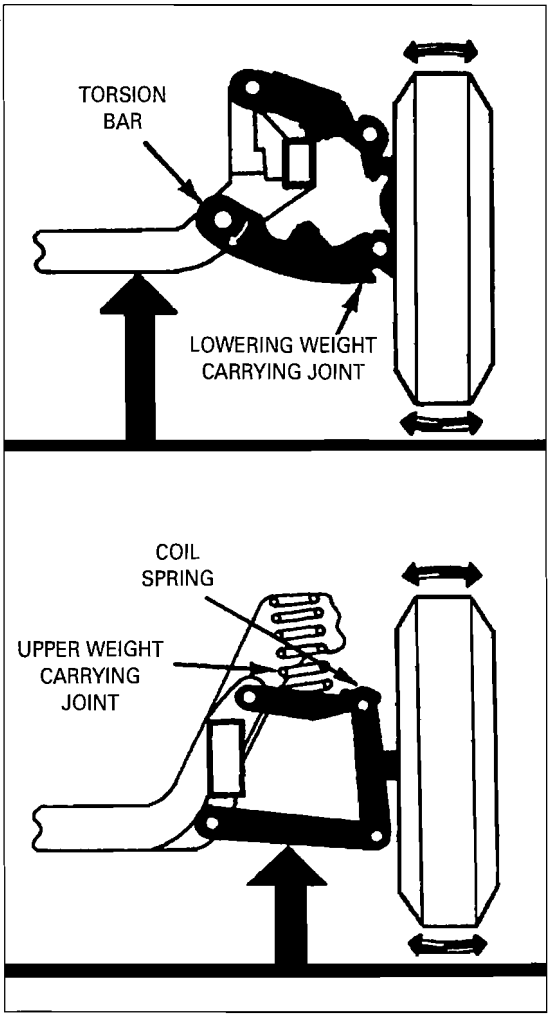
Procedure

With the vehicle lifted properly, grasp the tire at the top and bottom. Rock the tire in and out, and measure the movement following the manufacturer's recommendations if available. Wheel bearing looseness is detected by the relative movement between the brake drum or disc and the backing plate or splash shield.

Caution: If air suspension vehicles are hoisted via the body support area, make sure that the air suspension switch is turned "OFF" to avoid damaging the air spring.

Reject the vehicle if:

- The wheel bearing measurement exceeds the manufacturer's specifications. If no specifications are available, reject the vehicle if relative movement between the drum and backing plate (disc and splash shield) is more than 1/8 of an inch (3 mm) measured at the outer circumference of the tire.



Proper Lifting for Wheel Bearing and Steering Linkage Looseness (Check ball joints in loaded position.)

2. Steering Linkage, Lash/Travel, Steering Assembly

Lifting techniques vary for measuring steering linkage play. On front-wheel-drive vehicles, the inspector must consult the manufacturer's lifting information.

A. STEERING LINKAGE PLAY

Note: On vehicles with power steering, the engine must be running.

Procedure:

Step 1: Eliminate all wheel bearing movement by applying the service brake.

Step 2: With the vehicle resting on its wheels and the wheels in a straight-ahead position, rock the steering wheel back and forth as you watch the linkage.

Reject the vehicle if:

- There is noticeable lateral movement in any of the linkage joints.

B. LASH/TRAVEL

To inspect for lash/travel, the vehicle must be placed on a smooth dry, level surface. Before testing vehicles equipped with power steering, the engine must be running, fluid must be at the proper level, and the belt tension and condition must be adequate.

Equipment needed: Ruler, scale or lash-checking instrument.

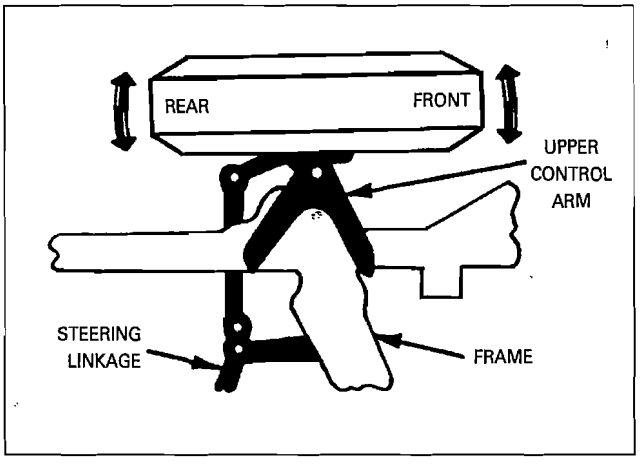
Procedure

Step 1: With the vehicle in a straight-ahead position, turn the steering wheel until motion can be detected at the front wheels.

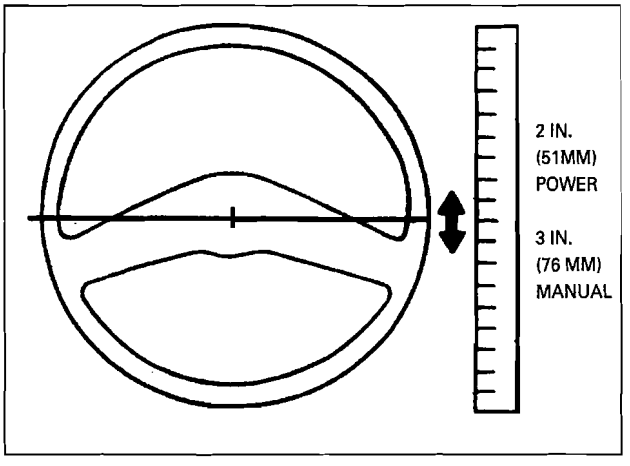
Step 2: Align a reference mark on the steering wheel with a mark on a ruler and slowly turn the steering wheel in the opposite direction until motion can again be detected at the front wheel.

Step 3: Measure lash at the steering wheel. Special lash-checking instruments are available that measure free play in inches or degrees. Such instruments should always be mounted and used according to the manufacturer's instructions.

Note: No play in the steering is permissible for Volkswagen and Audi vehicles. Consult the manufacturer's specifications for more information.



Steering Linkage Play—Top View



Steering Lash

Reject the vehicle if:

- Steering wheel movement exceeds:

Power	2 inches (51 mm)
Manual	3 inches (76 mm)
Rack and Pinion	See manufacturer's recommendations.

C. STEERING GEAR

Procedure

Step 1: With the vehicle on a level floor and with the engine shut down, rock the steering wheel left and then right and observe movement in the steering gear components (see Step 2).

Step 2: Visually inspect the bellows seal (rack and pinion only), screw clamp (rack and pinion only), mounting bolts, mounting brackets and mounting bushings.

Reject the vehicle if:

- The bellows seal is split open or missing.
- The screw clamp is bent or welded.
- Mounting bolts are missing, loose or have stripped threads.
- Mounting brackets are cracked or loose.
- Any movement is noted in the mounting bushings.

D. POWER STEERING

Procedure

Step 1: Check the fluid level and belt tension on the power steering pump. If necessary, advise the driver to bring the steering pump fluid to the proper level and make certain that the tension on the belts is properly adjusted before proceeding with the inspection.

Step 2: Check for fluid leaks or foaming.

Reject the vehicle if:

- Fluid is leaking excessively. (Seepage is permitted.)

E. STEERING SYSTEM TRAVEL

Procedure

Turn the steering wheel through a full right and left turn.

Reject the vehicle if:

- The front wheels cannot be turned to the right and left steering stops without binding or interference.

3. Front Wheel Alignment

There are five basic factors that are the foundation of front wheel alignment: caster, camber, toe, thrust angle and steering axis inclination. The first four factors are usually mechanically adjustable. The steering axis inclination is a part of the vehicle design and is not adjustable. Caster and camber are difficult to determine without sophisticated equipment and are not critical to safety unless excessively out of adjustment or damaged.

Overall front wheel alignment can be determined in a somewhat general manner by measuring the toe angle. If the vehicle has excessive toe-in or toe-out, a complete check may be necessary of all front wheel alignment factors.

A. FRONT WHEEL TOE

Equipment needed: Drive-over toe measuring device.

Procedure

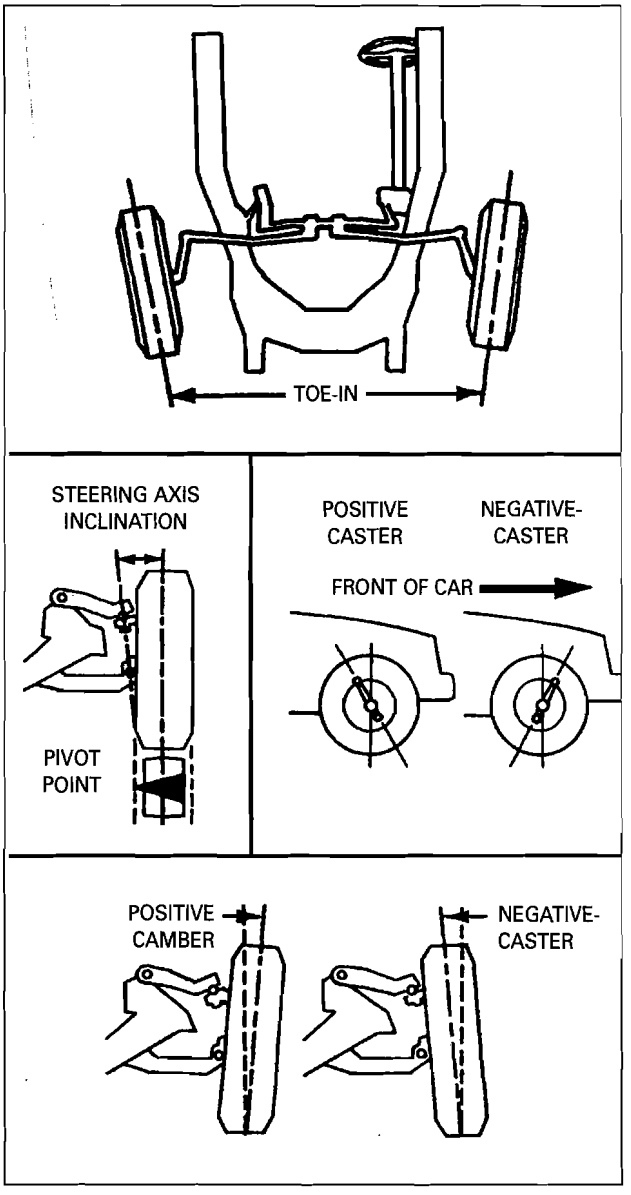
With wheels in a straight-ahead position and with hands momentarily off the steering wheel, drive the vehicle slowly over the toe measuring device.

Advise the driver if:

- Excessive toe-in or toe-out exists. The vehicle should be given an alignment check. (Accelerated tire wear can result from toe misalignment.)

Reject the vehicle if:

- The toe equipment indicates the wheels are out of alignment.
- There is noticeable movement to the right or left when the steering wheel is released while the vehicle is moving forward on a flat surface.



Wheel Alignment Factors

Torsion Bars, Springs, Shock Absorbers/Struts & Bumper Height

Equipment needed: Hoist or hydraulic jack and safety stand, scale, trouble light and yardstick or the equivalent.

1. Springs and Torsion Bars

Procedure

Step 1: With the unloaded vehicle on a level surface, visually inspect the heights of the four corners of the vehicle. If necessary, use a measuring device and determine the difference from side to side.

Step 2: Visually inspect for broken leaf springs, coil springs, air springs or torsion bar damage.

Step 3: Inspect spring shackles, bushings and the U-bolts.

Caution: If air suspension vehicles are hoisted via the body support area, make sure that the air suspension switch is turned "OFF" to avoid damaging the air spring.

Reject the vehicle if:

- The vehicle height is not within the manufacturer's recommended specifications.
- Springs or torsion bars are broken, and shackles or U-bolts are worn or loose.
- Air springs are collapsed.

2. Shock Absorbers/Shock Struts

Procedure

Step 1: With the vehicle on a level surface, push down on one corner of the vehicle and release. Observe rocking motion, if any.

Reject the vehicle if:

- The vehicle rocks freely after release, indicating a loss of shock absorber function.

Step 2: With the vehicle on a hoist or jacked up, visually inspect shock absorbers for excessive leakage, worn or torn bushings, or looseness of mounting brackets and bolts.

Reject the vehicle if:

- Severe leakage (not slight dampness) is evident.
- Mounting bolts, mounts or bushings are loose or broken.

3. Bumper Height

Passenger Cars Only

Procedure

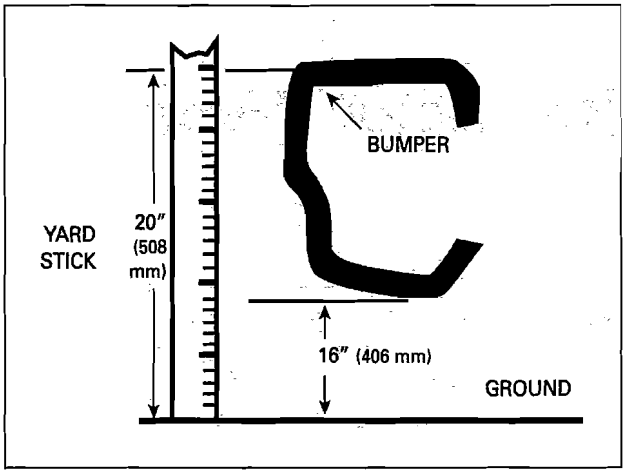
With the vehicle on a level surface, measure the height of the front and rear bumpers to the top and bottom of the horizontal bumper bars.

Note: On vehicles equipped with air suspension systems, the automatic level control must be activated to obtain an accurate bumper height.

Reject the vehicle if:

- Some part of the horizontal bumper bar does not fall within 16 to 20 inches (406 to 508 mm) above the level ground surface.

Note: In Canada, the bumper bar may fall within 14 inches to 22 inches (355 mm to 560 mm) above the level ground surface.



Bumper Height Measurements

Ball Joint Wear

There is a trend among United States automobile manufacturers toward the use of wear-indicating ball joints. Many vehicles on the road, however, do not have wear-indicating ball joints. The inspection of both types will be discussed.

Note: Vehicle manufacturers do not recommend injection of materials into ball joints or suspension steering components to fill voids caused by wear.

Reject the vehicle if:

- The ball joints or suspension steering components have been injected with any material or modified in any way to conceal wear.

Equipment needed: Dial indicator, swivel and clamp. Floor jack or hoist, safety stand, pry bar and vise grips.

1. Ball Joints Without Wear Indicators

Procedure

Step 1: Depending on the construction of the suspension system, unload the ball joints by properly raising the vehicle.

Caution: Unloading front air spring suspension at an incorrect location may result in a damaged air spring.

Step 2: Attach the dial indicator to the control arm to measure movement accurately between the ball joint and its socket.

Step 3: To check vertical movement, position a pry bar under the front tire. With a lifting motion sufficient to overcome the weight of the wheel assembly, move the wheel up and down. Observe movement shown on the dial indicator.

Step 4: To check the horizontal movement, grasp the tire and wheel assembly at the top and bottom. Move it in and out to detect any looseness. (More horizontal than vertical movement is allowable because of the nature of most ball joint construction. Some manufacturers do not accept horizontal movement as being indicative of ball joint wear.)

Note: In checking for vertical motion of ball joints, keep in mind that the load carrying joint is unloaded, and that pry bar pressure sufficient only to lift the weight of the wheel assembly is required. If the inspector uses the leverage of a pry bar to exert excessive pressure, this may easily force an apparent ball joint movement and give a false reading. This may result in the expensive replacement of perfectly good joints.

Reject the vehicle if:

- The ball joint movement exceeds the manufacturer's service specifications shown in the tables in this section. On 1993 and newer models, refer to the manufacturer's specifications.

2. Pre-loaded Ball Joints

Procedure

Using the same procedure as above, inspect for ball joint movement relative to its socket. These ball joints (marked "b" in Tables 1 and 2 in this section) are preloaded by rubber or springs under load or compression, and should have very little movement in a vertical direction—no more than specified in the tables.

Reject the vehicle if:

- Vertical movement exceeds the values specified in Tables 1 and 2 on the following pages. For models not listed in the tables, refer to the manufacturer's specifications.

3. Ball Joint Wear Tables

Domestic and Captive Imports*

TABLE 1

Manufacturer's Tolerance for Ball Joint Wear with Spring or Torsion Bar on Lower Control Arm

Note: For some earlier model year vehicles refer to the earlier editions of this handbook or the handbooks published by the American Automobile Manufacturers Association (formerly the Motor Vehicle Manufacturers Association).

Model	Year	Vertical Movement	Horizontal Movement
BUICK			
All models except listed	73-82	Wear Ind.	(a)
	82-93	.000	.000
Apollo	1974	.0625	(a)
Century	1981	.020(b)	(a)
	97-98	.000	.000
LeSabre, Wildcat, Electra Park Avenue, Centurion	73-88	Wear Ind.	(a)
LeSabre, Park Avenue	92-98	(c)	.000
LeSabre, Electra Estate Wagon	88-92	(c)	.125
Opel	74-75	.080	(a
	76-79	.040	(a)
Regal	74-87	Wear Ind.	.000
	97-98	.000	.000
Riviera	79-85	.125(d)	(a)
	96-98	(c)	.000
Roadmaster Wagon	91-96	Wear Ind.	(a)
Skylark	80-96	.000	(a)
CADILLAC			
All models except listed	82-96	.000	.000
Catera	97-98	.000	.000
Calais, DeVille (RWD) Fleetwood (RWD) Brougham (RWD)	74-96	Wear Ind.	(a)
Eldorado	79-85	.125(d)	(a)
	86-96	(c)	.000
Sedan DeVille, Concours	94-96	(c)	.000
Seville	76-80	Wear Ind.	(a)
	80-85	.125(d)	(a)
	86-92	(c)	.000
CHEVROLET			
All models except listed	73-81	Wear Ind.	(a)
	82-98	.000	.000
Biscayne, Bel Air, Impala, Caprice	73-95	Wear Ind.	(a)

*Captive imports are passenger cars imported by license agreements with U.S. motor vehicle manufacturers and sold through domestic dealerships.

TABLE 1—continued

Model	Year	Vertical Movement	Horizontal Movement
CHEVROLET, continued			
Camaro	74-95	Wear Ind.	(a)
	97-98	.046	(a)
Chevette	76-87	Wear Ind.	(a)
Citation	80-86	.000	.000
Corvette	71-82	.060	(a)
	84-95	Wear Ind.	(a)
	97-98	.000	.000
Deluxe, Malibu, Monte Carlo, Laguna, Nova	74-84	Wear Ind.	(a)
Lumina	97-98	.000	.000
Monte Carlo	97-98	.000	.000
CHRYSLER			
All models	77-88	.030(b)	(a & g)
DODGE			
All models	77-87	.030(b)	(a & g)
FORD			
All models thru '79, except listed	54-79	(c)	.250 (6mm)
Aspire	94-97	No Play	No Play
Contour	96-98	No Play	No Play
Escort	94-98	No Play	No Play
Fairmont	78-83	Wear Ind.	(a)
Festiva	86-95	No Play	No Play
Ford Crown Victoria	79-93	Wear Ind.	(a)
Ford Crown Victoria	94-98	(c)	.015
Granada	81-82	Wear Ind.	(a)
LTD	83-86	Wear Ind.	(a)
Mustang	79-83	Wear Ind.	(a)
Mustang	94-98	(c)	.015
Probe	94-97	No Play	No Play
Tempo	94-95	(c)	No Play
Thunderbird	80-88	Wear Ind.	(a)
Thunderbird	89-93	(c)	No Play
Thunderbird	94-97	(c)	.015
LINCOLN			
All models except, listed	52-79	(c)	.250(6mm)
Continental	82-87	Wear Ind.	(a)
Lincoln Town Car	80-93	Wear Ind.	(a)
Lincoln Town Car	94-98	(c)	.015
Mark	80-92	Wear Ind.	(a)
Mark	1993	(c)	No Play
Mark	94-98	(c)	.015
MERCURY			
All models except, listed	52-79	(c)	.250(6mm)
Capri	79-86	Wear Ind.	(a)
Capri	92-95	No Play	No Play
Cougar	83-88	Wear Ind.	(a)
Cougar	89-93	(c)	No Play
Cougar	94-97	(c)	.015
Grand Marquis	79-93	Wear Ind.	(a)
Grand Marquis	94-98	(c)	.015
LN7	81-86	No Play	No Play
Lynx	81-87	No Play	No Play
Marquis	83-86	Wear Ind.	(a)

TABLE 1—continued

Model	Year	Vertical Movement	Horizontal Movement
MERCURY, continued			
Mystique	95-98	No Play	No Play
Topaz	94-96	(c)	No Play
Tracer	89-98	No Play	No Play
Zephyr	78-83	Wear Ind.	(a)
XR-7	80-82	Wear Ind.	(a)
MERKUR			
Scorpio	88-89	-	-
XR4Ti	86-89	-	-
OLDSMOBILE			
All models except listed	73-81	Wear Ind.	(a)
	82-98	.000	.000
Aurora	96-98	(c)	.000
Cutlass (FWD)	82-95	.000	.000
Cutlass (RWD), F85			
Custom Cruiser	74-88	Wear Ind.	(a)
Custom Cruiser Wagon	1995	Wear Ind.	(a)
Eighty-Eight	74-85	Wear Ind.	(a)
Intrigue	1998	.000	.000
Ninety-Eight (RWD)	74-84	Wear Ind.	(a)
Omega	80-84	.000	.000
Toronado	79-85	.125(d)	(a)
PLYMOUTH			
All models except listed	77-86	.030(b)	(a & g)
Caravelle	85-87	.020(b)	See Table 2
PONTIAC			
All models except listed	73-81	Wear Ind.	(a)
	82-96	.000	.000
Bonneville	92-96	(c)	.000
Bonneville, Parisienne	74-86	Wear Ind.	(a)
Fiero	86-88		
	(front)	Wear Ind.	(a)
	(rear)	.000	.000
Firebird	74-95	Wear Ind.	(a)
Firebird	97-98	.046	(a)
Grand Am, Grand Prix,Lemans (Bonneville)	74-87	Wear Ind.	(a)
Grand Prix	97-98	.000	.000
Phoenix	82-85	.000	.000
Saturn	91-95	.000	.000

NOTE: Vehicles with wear indicating ball joints—inspect with ball joint loaded.

(a) Do not test ball joints by horizontal movement.

(b) Preloaded by rubber or springs.

(c) Do not test joints vertically. Check horizontal movement only using dial indicator.

(d) Measured at drive axle nut.

(e) Horizontal movement tests for American motors cars from 1970 through 1986 excluding Pacer. Play should be measured at outside wheel rim and not at the ball joint.

(f) No play allowed on lower ball joint.

(g) See inspection procedure Chrysler Ball Joint.

(h) Do not test ball joints by vertical movement.

(i) Vertical movement is checked by sight. Wear is indicated by the position of the housing into which the grease fitting is threaded. This round housing projects 1.27mm (0.050) beyond the surface of the ball joint cover on a new, unworn joint. Normal wear will result in the surface of the housing retreating very slowly inward.

(j) Do not pry between the lower control arm and the drive axle seal or in such a manner that the ball joint seal is contacted. Damage to the seal will result (4wd).

TABLE 2

Manufacturer's Tolerances for Ball Joint Wear with Spring or Torsion Bar on Upper Arm and McPherson Strut Suspension

Model	Year	Vertical Movement	Horizontal Movement
AMERICAN MOTORS			
All models except Pacer	70-80	.080	.160(e)
	81-88	(c) (f)	.160(e)
CHRYSLER			
E-Class, LeBaron, Fifth Avenue, Imperial, New Yorker	82-93	.000	(a)
Chrysler TC by Maserati	1991	.000	(a)
Cirrus	96-98	(g)	(g)
Concorde	93-96	(h)	.000(g)
Laser	84-86	.000	(a)
LeBaron	94-95	.000	(a)
New Yorker, LHS	94-97	(h)	.000(g)
DODGE			
Aries	1980	.050	(a)
Aries 400, 600	81-89	.000	(a)
Daytona	84-93	.000	(a)
Dynasty	88-93	.000	(a)
Intrepid	93-98	(h)	.000(g)
Lancer	85-89	.000	(a)
Monaco	91-92	.000	.000
Neon	95-98	.000	(a)
Omni	78-80	.050	(a)
Omni, Charger	81-90	.000	(a)
Shadow	87-94	.000	(a)
Spirit	89-95	.000	(a)
Stratus	95-98	(g)	(g)
Viper	92-98	(g)	(g)
EAGLE			
Medallion	1989	.000	.000
Premier	88-92	.000	.000
Vision	93-97	(h)	.000(g)
FORD			
Escort, EXP	81-93	No Play	No Play
Granada	75-80	(c)	No Play
Probe	89-93	No Play	No Play
Taurus	86-93	No Play	No Play
Taurus	94-98	(c)	No Play
Tempo	83-93	No Play	No Play
Tempo	94-95	(c)	No Play
Torino	68-79	(c)	.250(6mm)
LINCOLN			
Continental (FWD)	88-93	No Play	No Play
Continental (FWD)	95-98	(c)	No Play
Versailles	77-79	(c)	No Play
MERCURY			
Cougar	67-79	(c)	.260(6mm)
Monarch	75-80	(c)	No Play
Sable	86-93	No Play	No Play
MERCURY, continued			
Sable	94-98	(c)	No Play
Topaz	83-93	No Play	No Play
Topaz	94-95	(c)	No Play

TABLE 2—continued

Model	Year	Vertical Movement	Horizontal Movement
PLYMOUTH			
Acclaim	89-95	.000	(a)
Breeze	96-98	(g)	(g)
Horizon	78-80	.050	(a)
Horizon Turismo	81-90	.000	(a)
Neon	95-98	.000	(a)
Prowler	1997	(g)	(g)
Reliant	1980	.050	(a)
	81-89	.000	(a)
Sundance	87-94	.000	(a)

TABLE 3

Manufacturer's Tolerances for Ball Joint Wear—Light Trucks & MPV's

Model	Year	Vertical Movement	Horizontal Movement
CHRYSLER/PLYMOUTH/DODGE			
Ram Wagon/Van	94-98	.030	(a)
Ram 1500	94-98	.030	(a)
Ram 2500	94-98	.030	(a)
Ram 3500	94-98	.030	(a)
Caravan	84-98	.000	(a)
Dakota	94-96	.020	(a)
	97-98	.060"	(a)
Durango	1998	.060"	(a)
Town & Country	94-98	.000	(a)
Voyager	84-98	.000	(a)
FORD/MERCURY			
F-150, F-250, F-350	94-98	(h)	.031
F Super Duty Body	94-98	(h)	.031
Aerostar	94-97	(h)	.031
Bronco	94-96	(h)	.031
Econoline (all series)	94-98	(h)	.031
Explorer	94-98	(h)	.031
Ranger	94-98	(h)	.031
Villager	94-96	No Play	(a)
Windstar	95-96	(h)	No Play
GENERAL MOTORS/CHEVROLET/OLDSMOBILE/PONTIAC			
Astro, Safari	94-98	Wear Ind. (i)	.125
Chev. Full Van, Rally, Vandura Van, G10 & G20 Models	94-98	Wear Ind. (i)	(a)
G30 Models	94-98	Wear Ind. (i)	.125
Express	1998	.080	.125
Savana	1998	.080	.125
GMC and Chevrolet Sierra Pickup GMC Yukon, Chevrolet Tahoe/Blazer GMC and Chevrolet Suburban			
2 Wheel Drive	94-98	Wear Ind. (i)	.125
4 Wheel Drive	94-98	.080(j)	.125
Lumina APV	90-98	.020	(a)
Silhouette	90-96	.020	(a)
	97-98	.000	.000
Transport	90-96	.020	(a)
	97-98	.000	.000

TABLE 3—continued

Model	Year	Vertical Movement	Horizontal Movement
Venture	97-98	.000	.000
GMC and Chevrolet S-T Pickup and Utility			
2 Wheel Drive	94-98	Wear Ind.(i)	.125
4 Wheel Drive	94-98		
Bravada	94-98	.025	.125

IMPORTS

TABLE 4

Manufacturer's Tolerances for Ball Joint Wear With Spring or Torsion Bar on Lower Arm

Model	Year	Vertical Movement	Horizontal Movement
ACURA			
All models	86-89	Do Not Test	Do Not Test
ALFA ROMEO			
All models	57-86	.060"	Do Not Test
BMW			
All models except listed	75-89	1.4mm	Do Not Test
318i	84-85	1.0mm	Do Not Test
325i	84-89	1.0mm	Do Not Test
735i, 750i	87-89	1.0mm	Do Not Test
HONDA			
Civic, CRX	84-89	Do Not Test	Do Not Test
Accord	86-89	Do Not Test	Do Not Test
Prelude	83-89	Do Not Test	Do Not Test
INFINITI			
All models except listed	90-98	.000	None
M30	90-92	.050	None
JAGUAR			
All models	72-87	.060"	.040
All models	88	.006	.007
MITSUBISHI			
Montero	Thru 99	Do Not Test	Do Not Test
Van/Wagon	Thru 99	Do Not Test	Do Not Test
Truck	Thru 99	Do Not Test	Do Not Test
ROLLS ROYCE			
All models	67-88	None	None
TOYOTA			
Supra	Thru 89	.012 (lower)	None
Trucks, 4 Runner	Thru 89	.091 (w/o load)	None
Celica	86-87	None	None
Camry	86-87	None	None
Starlet	81-84	None	None
VOLVO (I)			
All models except listed	Thru 88	3mm	Do Not Test
140, 164 (with spring joint)	Thru 88	5mm	Do Not Test

*Information for foreign manufacturers was furnished by the Association of International Automobile Manufacturers, Inc. and is limited to models represented by their membership.

TABLE 5

Manufacturer's Tolerances for Ball Joint Wear with Spring or Torsion Bar on Upper Arm and McPherson Strut on Lower Control Arm

Model	Year	Vertical Movement	Horizontal Movement
AUDI			
All models	Thru 99	None	None
DATSUN/NISSAN (i)			
All models except listed	68-88	.040"	None
All models except listed	89-98	.000	None
F10, 310 Sentra, Pulsar	76-86	.060"	None
Stanza (except wagon)	82-86	.080"	None
Sentra	86-87	.050	None
Sentra	88	.000	None
Maxima, Stanza, Stanza Wagon, 200/240SX, 300ZX, Pulsar/NX	88	.100	None
300ZX	89	.100	None
Stanza	89	.040	None
Van	87-90	.060	None
HONDA			
Civic	Thru 83	.020"	Do Not Test
Accord	Thru 85	.020"	Do Not Test
Prelude	Thru 82	.020"	Do Not Test
ISUZU			
Impulse, Stylus	90-93	.040	Do Not Test
MAZDA			
All models	81-88	(m)	(m)
MITSUBISHI			
Galant	Thru 99	Do Not Test	Do Not Test
Mirage	Thru 99	Do Not Test	Do Not Test
PEUGEOT			
All models	66-88	None	None
ROVER			
3500	81	None	None
SAAB			
9000	86-88	None	None
SUBARU			
All models	73-84	Do Not Test	Do Not Test
All models (except Justy)	85-89	.012"	Do Not Test
Justy	87-89	.016"	Do Not Test
TOYOTA (l)			
Celica	Thru 89	None	None
Corolla (RWD)	Thru 87	.098"	None
Corolla (FWD)	Thru 89	None	None
Cressida	Thru 89	.098"	None
Tercel	Thru 89	None	None
MR-2	Thru 89	None	None
Camry	Thru 89	None	None
Starlet	81-84	None	None
VOLKSWAGEN (k)			
All models	Thru 99	None	None
VOLVO (k)			
240, 260, 760	Thru 88	3mm	Do Not Test

TABLE 6

Manufacturer's Tolerances for Ball Joint Wear with Spring or Torsion Bar on Upper Arm

Model	Year	Vertical Movement	Horizontal Movement
CITROEN			
All models	Thru 85	None	None
MAZDA (l)			
B2000	Thru 85	(m)	(m)
SAAB			
9000	Thru 88	None	None
TOYOTA			
Van	Thru 89	.091 (w/o load)	None

(k) Ball joints with damaged boots should be replaced.

(l) Check vertical ball joint movement with ball joints fully loaded. With vehicle resting on all wheels, use a pry bar or similar leverage to apply vertical force to lower control arm at ball joint and observe play on properly attached dial indicator.

(m) **Criteria of Mazda Model Ball Joints.**

Model	Year	Vertical Movement	Horizontal Movement
GLC	81-85	63-109	*1
GLC Wagon	81-86	0.88 or more	*2
RX-7	81-85	0.88 or more	*2
86-88	4.4-7.7	*3	
323	86-88	1.8-3.1 N'm	*3
626	83-88	4.4-7.7	*3
929	88	1.1-2.6	*3
B2000	86-87	40 or less	*3
B2200	87-88	4.4-7.7	*3
B2600	87-88	4.4-7.7	*3

*1 Measure the turning force at the end of the ball joint arm by using a pull scale.

*2 Measure the turning force at the end of the knuckle arm by using a pull scale.

*3 Install the Mazda special tool to the ball stud and then measure by using a pull scale.

4. Ball Joints With Wear Indicators

Wear indicator ball joints are inspected with the weight of the vehicle on the wheels. This inspection should be done either on the floor or on a drive-on lift.

Procedure

Wipe the dirt and grease from the fitting and checking surface (see illustration on page 44). Determine if the checking surface extends beyond the surface of the ball joint cover.

Reject the vehicle if:

- The checking surface is flush with or inside the cover surface.

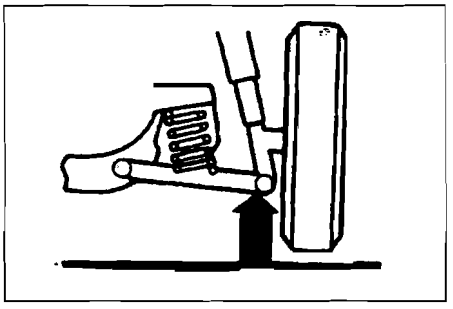
5. Other Ball Joint Systems

A. FORD MOTOR COMPANY

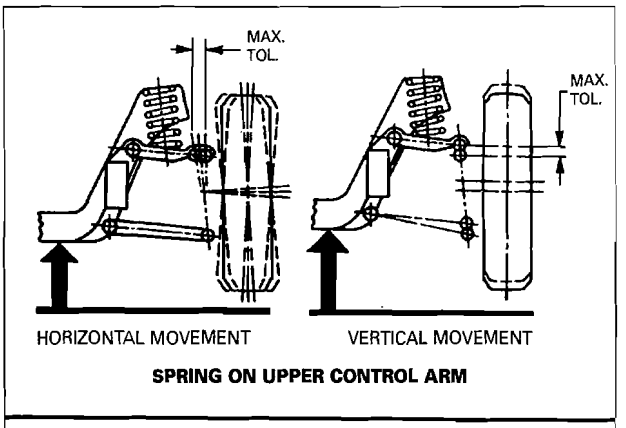
Capri (1979–1994)
Fairmont & Zephyr (1978–1983)
Mustang (1979–1993)
Lincoln (1980–1993)
Continental (1982–1987)
Granada (1981–1982)
LTD & Marquis (1983–Present)
Mark (1980–1993)

Procedure

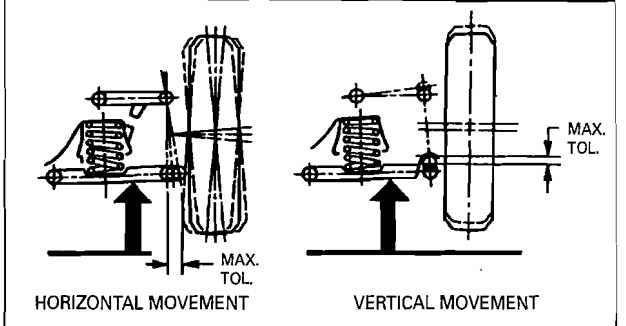
These models have a wear-indicating single lower ball joint system. Wear indicator ball joints are inspected with the vehicle weight on the wheels. Inspect using the same procedure as for ball joints with wear indicators.



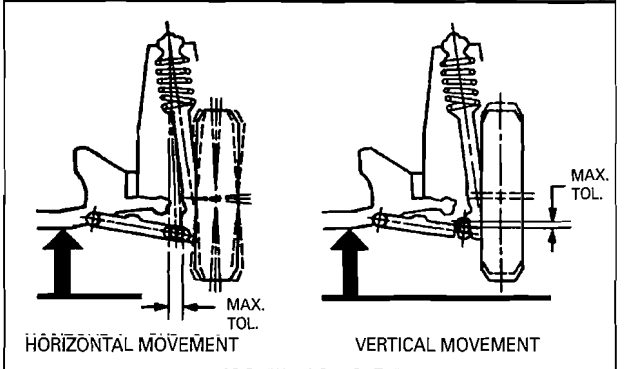
Select Ford—Lower Ball Joint



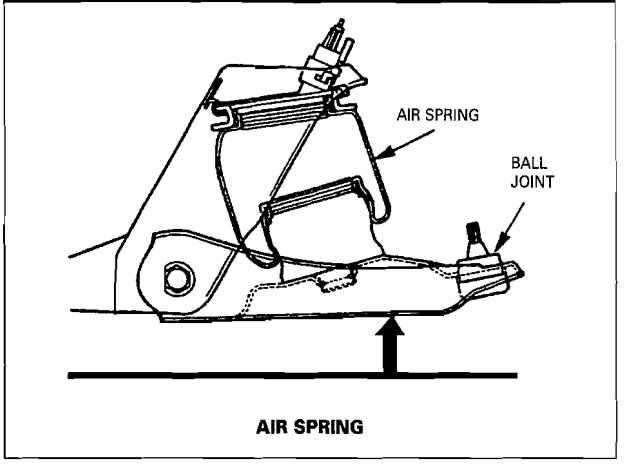
SPRING ON UPPER CONTROL ARM



SPRING OR TORSION BAR ON LOWER CONTROL ARM

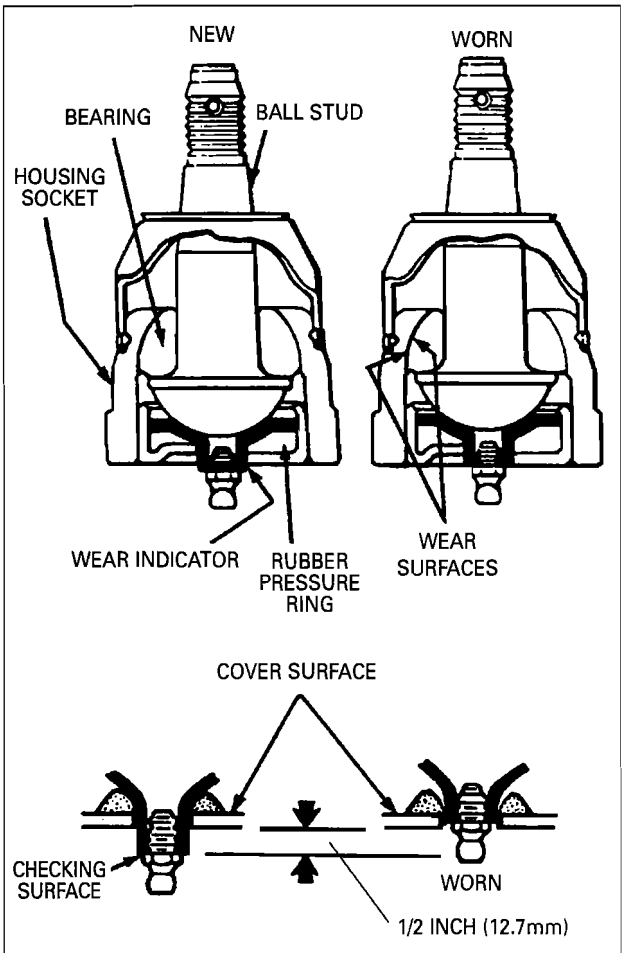


MACPHERSON STRUT



AIR SPRING

Raising Positions for Suspension Systems



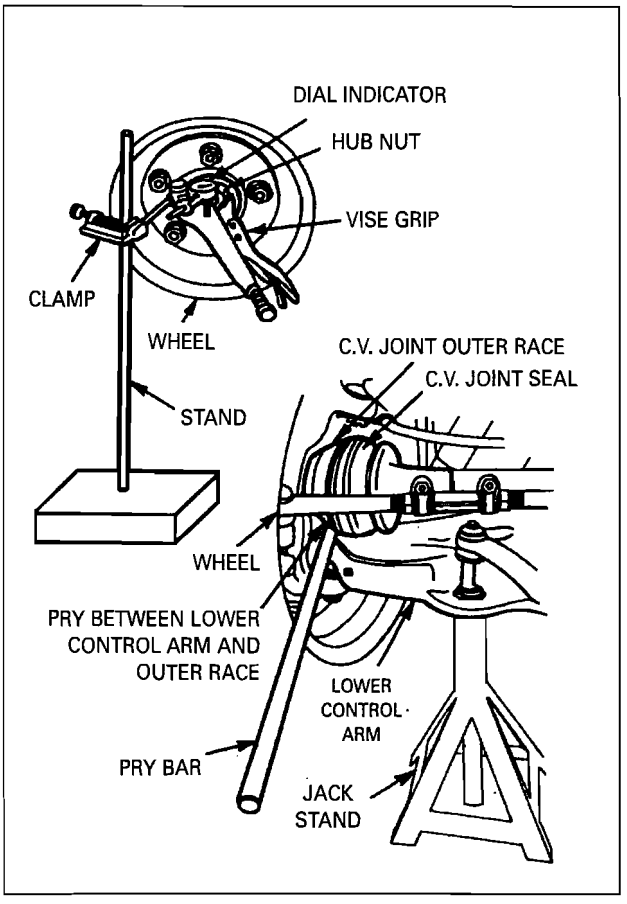
BALL JOINT WEAR INDICATOR

Wear is indicated by the protrusion of the 1/2 inch (12.7mm) diameter boss, (exaggerated for illustration) into which the grease fitting is threading for greaseable ball joints. This same boss exists and should be used to indicate wear in non-greaseable ball joints. This round boss projects 1/2" (12.7 mm) beyond the surface of the ball joint cover on a new, unworn joint.

To inspect for wear, support vehicle by wheels so that the lower ball joints are in a loaded condition. Wipe the grease fitting or boss free of dirt and grease. Observe or scrape a scale, screwdriver, or fingernail across the cover. If the grease fitting boss is flush or inside the cover surface, reject the vehicle.

Step 1: Position the vehicle on the floor or on a drive-on lift, with the vehicle weight on the wheels, and with the ball joints loaded.

Step 2: Wipe the dirt and grease from the fitting and checking surface (see illustration). Determine if the checking surface extends beyond the surface of the ball joint cover.



GM—El Dorado, Riviera, Seville, and Toronto Lower Ball Joints

Reject the vehicle if:

- The checking surface is inside the ball joint cover.

B. GENERAL MOTORS

Cadillac El Dorado (1979–1985)

Buick Riviera (1979–1985)

Oldsmobile Toronado (1979–1985)

Cadillac Seville (1980–1985)

Procedure

Step 1: Support the vehicle under the lower control arm to unload the lower ball joint.

Step 2: Attach and lock the vise grips to the hub nut and position the dial indicator on its stand with the dial indicator plunger tip against the vise grip.

Step 3: Position a pry bar on the top of the lower control arm with the bar tip under the outer race of the constant velocity joint. Try to raise and lower the hub assembly. Caution should be used to avoid damage to the boot.

Step 4: Observe the movement between the lower control arm and the other race on the dial indicator.

Reject the vehicle if:

- Vertical movement exceeds .125 inches (3.2 mm).

C. GM TRANSVERSE ENGINE Front-Wheel Drive Vehicles

Procedure

Step 1: Support the vehicle by positioning a lift or jack under the cradle.

Step 2: Grasp the wheel at the top and bottom. Shake the top of the wheel using an in and out motion. Observe any movement of the steering knuckle relative to the control arm. This visual observation is necessary to avoid confusion with other conditions such as loose wheel bearings.

Note: The ball joint is internally spring loaded.

Reject the vehicle if:

- The ball joint shows any movement.

D. CHRYSLER FRONT-WHEEL-DRIVE VEHICLE Lower Ball Joint Only

Procedure

With the weight of the vehicle resting on the road wheels, grasp the grease fitting as shown. Try to move the fitting. No mechanical assistance or added force is necessary.

Reject the vehicle if:

- The grease fitting shows any movement.

E. CHRYSLER Upper Ball Joint

Procedure

Step 1: Position a jack under the lower control arm and raise the wheel clear of the floor.

Step 2: Lower the jack to allow the tire to contact the floor lightly, keeping most of the vehicle weight off the tire. It is important that the tire be in contact with the floor.

Step 3: Grasp the top of the tire and apply force using an in and out motion. While this force is being applied, an observer should check for any movement at the ball joints between the upper control arm and the knuckle.

Reject the vehicle if:

- Any lateral movement is evident.

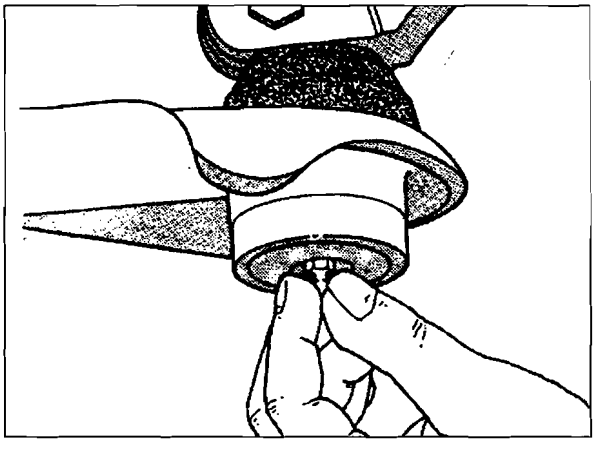
F. VEHICLES EQUIPPED WITH MACPHERSON STRUT JOINT

Procedure

Jack up the vehicle so as to unload the strut joint. Observe the horizontal and vertical movement.

Reject the vehicle if:

- The wear exceeds the manufacturer's recommendations.



Chrysler Front-Wheel Drive Lower Ball Joint

Lighting & Electrical

1. Pre-inspection Preparations

Prior to a general lighting inspection, the following preparations should be made. The driver is responsible for steps one through four. If these are not reasonably accomplished, the inspector should refuse to proceed until the vehicle is satisfactorily prepared.

Procedure:

Step 1: Remove excessive ice and/or mud from under the fenders.

Step 2: Inflate the tires to specified pressures.

Step 3: See that the vehicle contains no load other than the driver in his/her normal position.

Step 4: Be sure the lenses are clean. Check for burned out bulbs and proper beam switching. Replace headlamps with cracked or broken aiming pads or lenses, or with visible moisture on the interior.

Step 5: See that there is no faulty wheel alignment or improper tracking of the rear axle.

Step 6: Check the suspension. See that the vehicle does not lean to one side or the other. Rock the vehicle sideways to free and equalize the suspension.

2. Lamp Function

Procedure:

Step 1: Turn on the night driving lights.

Step 2: Activate the left and right turn signals and observe the function of the turn signal lights, indicator lamps and the front cornering lamp (if so equipped).

Step 3: Place the vehicle in reverse gear and check the backup lamps.

Step 4: Turn on the engine and observe if the daytime running lights (if so equipped) operate continuously when the engine is running and when the master lighting switch is in the "OFF" position. The lights must be located on the front of the vehicle and must be yellow or white.

Note: In Canada, daytime running lights are required on all vehicles manufactured after December 1, 1989. In the United States, daytime running lights are optional.

Step 5: Turn on and observe the following:

- Fog lamps (if so equipped)
- Hazard warning lamps
- Stop lamps
- Headlamps upper and lower beam
- Tail lamps
- Parking lamps
- Side marker lamps
- Instrument panel lamps
- Clearance lamps
- Identification lamps
- Emergency warning lamps
- License plate lamps
- Red brake warning light
- System failure indicator lights
- All other lights

WARNING: Avoid touching or contacting the inner bulb in halogen headlamps, halogen driving lamps or replaceable halogen headlamp bulbs. Severe burns and damage to the bulb could result.

Reject the vehicle if:

- Any prohibited lamp or lens is present. (See United States Federal Safety Standards 49 CFR 571.108 or Canadian Motor Vehicle Safety Standards 108.)
- Any required lamp is missing.
- Any bulb or sealed beam unit fails to light.
- Turn signals do not properly indicate right and left when switched.
- A turn signal switch fails to cancel.
- Backup lights do not turn off automatically when the vehicle is placed in a forward gear.
- A lamp shows a color that is not allowed by law. (See United States Federal Safety Standards 49 CFR 571.108 or Canadian Motor Vehicle Safety Standards 108.)
- A lamp fails to light when its switch is turned on, or the switch turns on a different lamp than the one indicated.
- Any lamp or reflector does not direct light properly.
- Auxiliary equipment is placed on, in or in front of any lamp, except headlamps with transparent covers originally equipped on the vehicle.
- A lamp assembly is fastened improperly.
- A lamp has a cracked, broken or missing lens, or there is visible moisture on the interior of the lens.
- Any headlamp fails to have the letters "DOT" or "SAE" marked horizontally or vertically on the lens.
- Any headlamp has the word "motorcycle" on the lens.
- The brake warning light does not function.
- The system failure light does not light or flash.

3. Headlamp Aiming—General Information

A. EQUIPMENT COMPLIANCE

All equipment for testing headlamps must comply with the *Society of Automotive Engineers Recommended Practice for Headlamps Inspection Equipment.*

B. HEADLAMP TESTING MACHINE

If a headlamp testing machine is used, it should give results equivalent to those obtained by using the screen procedure described in Section 7-5. It should be in good repair and adjustment, and should be used in accordance with the manufacturer's instructions. A machine using a photoelectric cell or cells to determine aim also should have a visible screen upon which the beam pattern is projected proportional to its appearance and aim on a screen at 25 feet. Such visual screen should be plainly visual to the operator and should have horizontal and vertical reference lines to permit visual appraisal of the lamp beam.

4. Headlamp Aiming—Mechanical Method

Equipment Needed: Approved set of mechanical aimers. Calibrate mechanical aimers to zero for vertical aim. Consult the aimer instruction manual for procedures.

Note: If a mechanical aimer is used, it should be in good repair and adjustment and should be used according to the manufacturer's instructions. It also must be calibrated to the slope of the floor on which the vehicle is placed.

Procedure:

Step 1: Make sure the vehicle is properly prepared for the inspection. (See Chapter 7–1.)

Step 2: Position the vehicle on a level area, loaded normally with the driver behind the wheel.

Step 3: To ensure proper height for vehicles with active (load-leveling) suspension systems, activate the air suspension system by operating the engine during the headlamp aiming/adjustment inspection and keep the doors of the vehicle closed.

Step 4: Follow the procedure recommended by the aiming equipment manufacturer.

Note: United States headlamps are either sealed beam, replaceable bulb types or integral beam headlamps equipped with the onboard aim device or Vehicle Headlamp Aim Device (VHAD). Vehicles with VHAD do not require separate mechanical aim devices because this aim function may be performed without mechanical aimers. (See the VHAD aiming procedure in this chapter.)

A. SEALED BEAM HEADLAMPS AIMING INFORMATION

1. 177 mm diameter—2D1 both upper and lower beam.
2. 146 mm diameter—1C1 upper, 2C1 lower beam.
3. 142 x 200 mm rectangular—2B1 both upper and lower beam.
4. 100 x 165 mm rectangular—1A1 and 1G1 upper beam, 2A1 and 2G1 lower beam, and 2E1 and 2H1 both upper and lower beam.
5. 92 x 150 mm rectangular—UF upper beam, LF lower beam.
6. 55 x 135 mm rectangular—UK upper beam, LK lower beam.

B. REPLACEABLE BULB HEADLAMP AIMING INFORMATION

1. 9004, 5.6 replaceable bulb, upper and lower beam.
2. 9005 and 9006 together, upper and lower beam.
3. 9005 and 9006 in separate headlamps, upper and lower beam, respectively.

Note: Lamps with a 9004 bulb may or may not be marked with HB1 on the lens. Lamps with 9005 are marked HB3 on the lens. Lamps with 9006 are marked HB4 on the lens.

C. UPPER BEAM (TYPE 1, UF OR UK) OR REPLACEABLE BULB TYPE 9005 (HB3)

Equipment Needed: Approved set of mechanical aimers. Calibrate mechanical aimers to zero for vertical aim. Consult the aimer equipment instruction manual for procedures. (See headlamp aiming preparation information in Chapter 7–1.)

Procedure

Attach a mechanical aimer to the headlamp in accordance with the aimer instruction manual. Take readings.

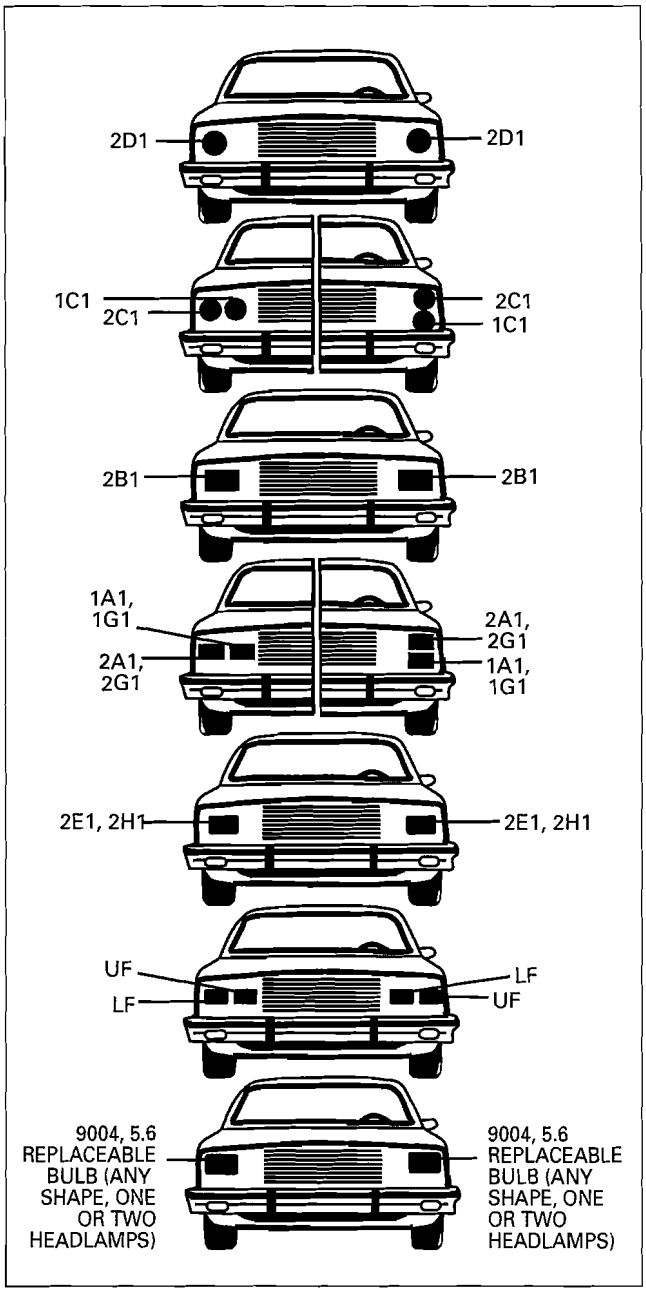
Reject the vehicle if:

- The horizontal aim is more than 4 inches (100mm) to the left or 4 inches (100mm) inches to the right of the horizontal centering line.
- The vertical aim is higher than 4 inches (100mm) up or lower than 4 inches (100mm) down from the vertical centering line.

D. LOW BEAM (TYPE 2, LF OR LK) OR REPLACEABLE BULB TYPE 9004 (HB1) OR 9006 (HB4)

Procedure

Attach a mechanical aimer to the headlamp in accordance with the aimer instruction manual. Take readings.



Type 1, Type 2, LF/UF Replacement Bulb Headlamps and Integral Beam Units may mount to any of the above locations.

Reject the vehicle if:

- The horizontal aim is more than 4 inches (100mm) to the left or 4 inches (100mm) to the right of the horizontal centering line.
- The vertical aim is higher than 4 inches (100mm) up or lower than 4 inches (100 mm) down from the vertical centering line.

  Note: All equipment for testing headlamps must comply with the *Society of Automotive Engineers Recommended Practice for Headlamp Inspection Equipment.* If a mechanical aimer is used, it should be in good repair and adjustment. It should be used according to the manufacturer's instructions, and it must be calibrated to the slope of the floor on which the vehicle stands.

5. Headlamp Aiming—On-board Device

On vehicles equipped with Vehicle Headlamp Aim Device (VHAD), aiming and aim checks may be performed on a vehicle if the vehicle is placed on a level surface, which may be four level pads on which the tires rest. The vehicle should be loaded normally with the driver seated behind the wheel in a normal position. Preparation of the vehicle is similar to other aiming methods as far as the physical condition of the vehicle. (See *Chapter 7–1.*)

A. VHAD—VEHICLE HEADLAMP AIMING DEVICE METHOD

Procedure

With the vehicle positioned on a level surface and normally loaded, check the horizontal indicator and position of the vertical aim bubble relative to the scale. The correct aim is zero for horizontal and vertical.

Reject the vehicle if:

- The horizontal indicator shows:
  - More than 0.8 degrees left, or
  - More than 0.8 degrees right.

- The vertical aim bubble shows:
  - More than 0.8 degrees up, or
  - More than 0.8 degrees down.

6. Headlamp Aiming—Screen Method

A. AIMING AREA REQUIRED

It is desirable to have a specific aiming area in a darkened location. This area should be sufficiently large enough for the vehicle and an additional 25 feet (7.5 m) measured from the face of the lamps to the front of the visual screen.

The floor on which the car rests must be flat with the bottom of the screen. If the floor is not level, compensate with leveling pads.

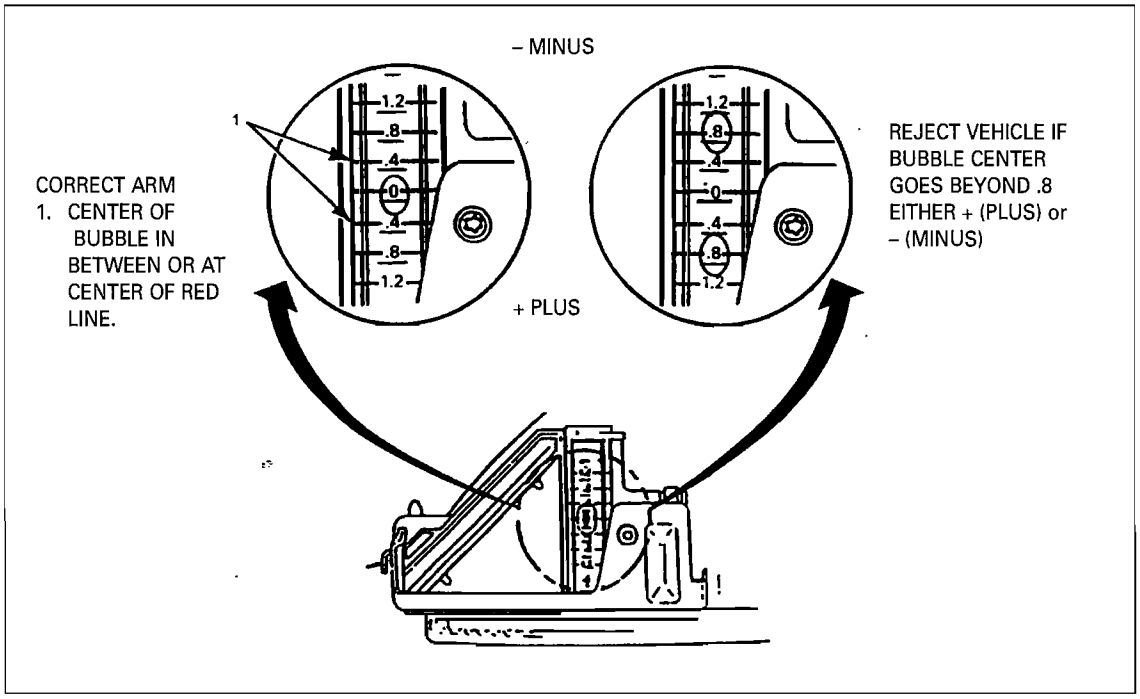
B. AIMING SCREEN

If a screen is used, it should be 5 feet (1.5 m) high and 12 feet (3.6 m) wide, with a matte white surface. It should be well shaded from extraneous light and properly adjusted to the floor on which the vehicle rests. Provisions may be made for moving the screen so that it can be aligned parallel with the rear axle, and so that a horizontal line drawn perpendicularly from the centerline of the screen will pass an equal distance midway between the two headlamps.

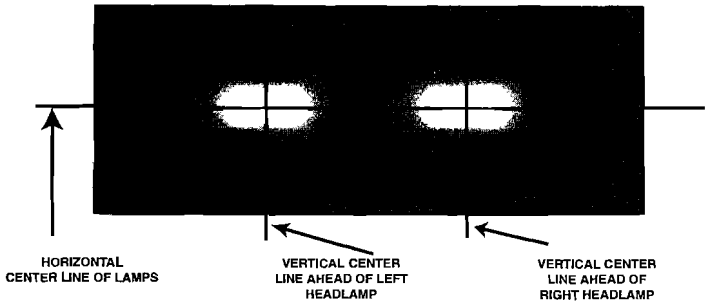
The screen should be equipped with a vertical centerline, two laterally adjustable vertical tapes, and one vertically adjustable horizontal tape.

If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear, uninterrupted area approximately 6 feet (1.8 m) high and 12 feet (3.6 m) wide. The surface should be finished with a washable non-gloss white paint.

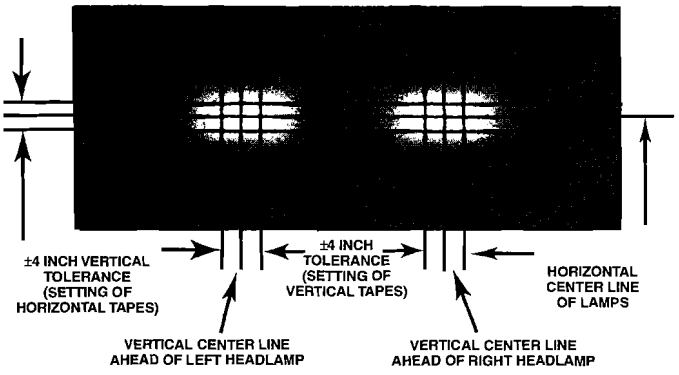
After the aiming screen has been set up in its permanent location, it will be necessary to paint a reference line on the floor directly under the lens of the lamps to indicate where the headlamps should be located when they are aimed.



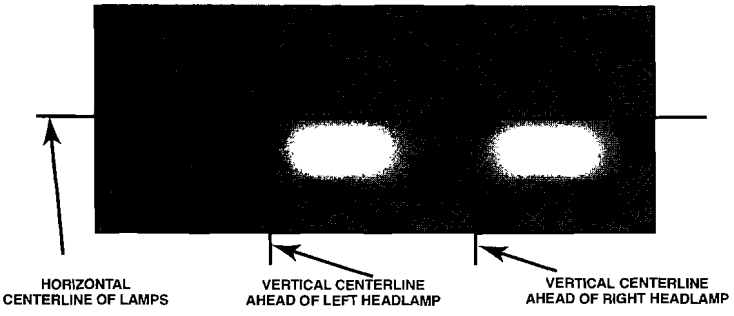
Vehicle Headlamp Aiming Device (VHAD)—Vertical Aim



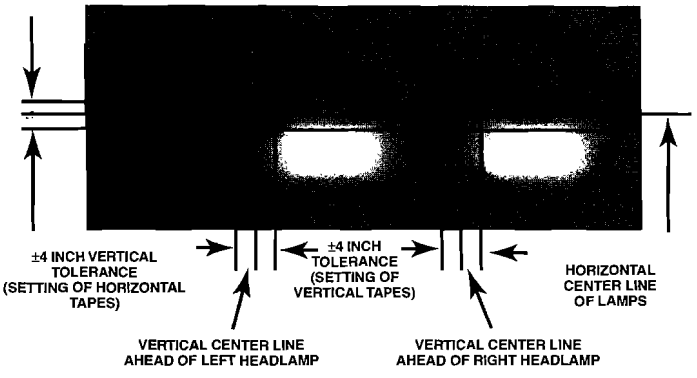
CORRECT AIM ADJUSTMENT FOR HIGH BEAM



AIM INSPECTION LIMITS FOR UPPER BEAM HEADLAMPS



CORRECT AIM ADJUSTMENT FOR HIGH BEAM



AIM INSPECTION LIMITS FOR UPPER BEAM HEADLAMPS

C. USING THE SCREEN METHOD

Procedure:

Step 1: Make sure the vehicle is loaded normally with the driver behind the wheel.

Step 2: To ensure proper height for vehicles with active (load-leveling) suspension systems, activate the air suspension system by operating the engine during the headlamp aiming/adjustment inspection, and keep the doors of the vehicle closed.

Step 3: Locate the vehicle so that it is level and square with the screen. The front of the headlamps should be directly over a reference line painted on the floor.

Step 4: Locate the centerline on the aiming screen so that it is in line with the center of the vehicle. This can be done by sighting through the center of the rear window of the vehicle and over the hood ornament. Have the vehicle moved, move the centerline on the screen or move the screen until the centerline is aligned with the center of the vehicle.

If the vehicle does not have a center hood ornament, mark the center of the front and rear windows with narrow strips of masking tape. Use these sights to locate the centerline of the aiming screen directly in line with the vehicle axis.

Step 5: Observe the aim of the beams, and compare the readings with the manufacturer's recommendations for specific lamp types.

D. UPPER BEAM
Type 1 or UF< UK, or Replacement Bulb Type 9005 (HB3) Used Above

Equipment: Approved marked screen and adequate test area.

Procedure

With the vehicle located and loaded properly, switch the headlamps to the upper beam and observe the center of the high intensity zone on the screen.

Reject the vehicle if:

- The center is horizontally:
  - More than 4 inches (100mm) right of straight-ahead, or
  - More than 4 inches (100mm) left of straight-ahead.
- The center is vertically:
  - More than zero inches (0.0 mm) above the horizontal line, or
  - More than 4 inches (100mm) below the horizontal line.

E. LOW BEAM
Type 2, LF, LK, or Replaceable Bulb, Type 9004 (HB1) or Type 9005 (HB3) and Type 9006 (HB4) Together

Procedure:

With the vehicle located and loaded properly, switch the headlamps to low beam and observe the left and top edges of the high intensity zone on the screen.

Note: ALWAYS inspect the following sealed beam and replaceable bulb headlamps on low beam only:

- 5-3/4 inches, marked 2, 2C or 2C1.
- 7 inches, marked 2, 2C or 2D1.
- 100 x 165 mm rectangular, marked 2A, 2A1, 2E1, 2G1 or 2H1.
- 200 x 142 mm rectangular, marked 2B or 2B1.
- Replaceable bulb headlamps with 9004 (HB1).
- 92 x 160 mm rectangular, marked LF.
- Replaceable bulb headlamps with 9006 (HB4) alone or in combination with 9005 (HB3).
- 55 x 135 mm rectangular, marked LK.

Reject the vehicle if:

- The left edge is horizontally more than:
  - 4 inches (100mm) left of straight-ahead, or
  - 4 inches (100mm) right of straight-ahead.

Reject the vehicle if:

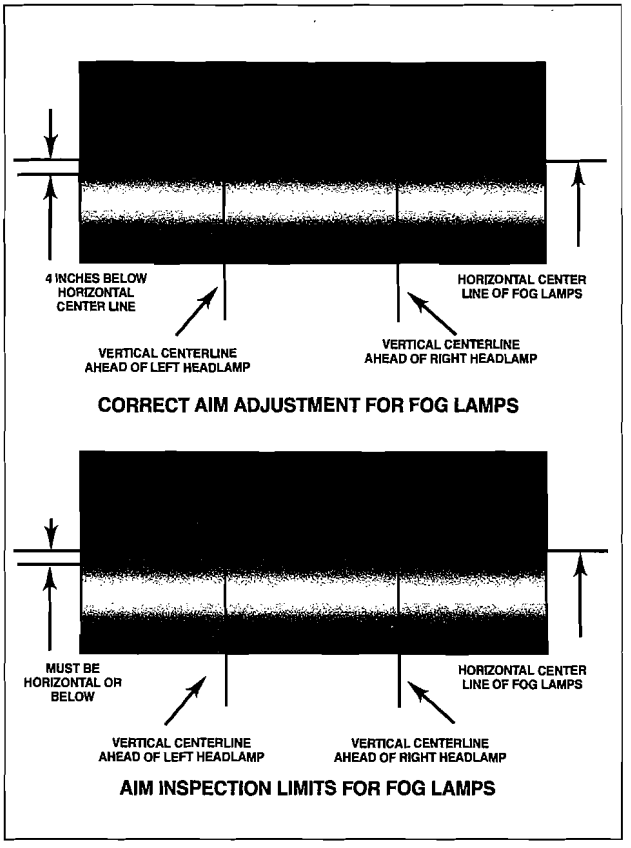
- The top edge is vertically more than:
  - 0 inches (0.0 mm) above the horizontal line, or
  - 4 inches (100 mm) below the horizontal line.

7. Fog Lamp and Auxiliary Driving Light Aiming—Screen Method

If a vehicle is equipped with fog lamps, they should be aimed properly. The moveable horizontal and vertical lines on the aiming screen should be located so that they cross at the straight-ahead positions of the center line of each fog lamp, whether they are symmetrical or nonsymmetrical.

Procedure

With the vehicle located and loaded as it is normally driven with the driver behind the wheel, switch on the fog lamps and observe the location of the high intensity zone on the screen.



A. SYMMETRICAL BEAM

When aimed properly, the top edge of the high intensity zone is set 4 inches (100mm) below the horizontal centerline of the fog lamps, and the center of the high intensity zone is set on the vertical centerline. (See illustration.)

Reject the vehicle if:

- The top edge is vertically above the centerline.

B. NONSYMMETRICAL BEAM

When aimed properly, the top edge of the high intensity zone is set at the horizontal centerline of the fog lamp, and the left edge of the high intensity zone is set at the vertical centerline. (Same as low beam Type 2 headlamps.)

Reject the vehicle if:

- The left edge of the high intensity zone is horizontally:
  - More than 0 inches (0 mm.) left of the straight-ahead line, or
  - More than 8 inches (200 mm) to the right of the straight-ahead line.

Reject the vehicle if:

- The top edge is vertically:
  - More than 0 inches (0 mm.) above the horizontal line, or
  - More than 4 inches (100 mm) below the horizontal line.

8. Lighting Codes

SAE PASSENGER CAR IDENTIFYING CODE FOR LIGHTS AND SIGNALING DEVICES

Device	SAE Identification Code Designation
Reflex Reflectors	A
Motorcycle Auxiliary Front Lamps	C
Motorcycle and Motor Driven Cycle Turn Signal Lamps	D
Side Turn Signal Lamps—Vehicles more than 9.1 m in Length	E
Side Turn Signal Lamps—Vehicles less than 9.1 m in Length	E2
Front Fog Lamps	F
Rear Fog Lamp	F2
Sealed Beam Headlamps (Marking Applies to Housing or Unit)	H
Sealed Beam Headlamp Housing	HH
Replaceable Bulb Headlamp	HR
Turn Signal Lamps	I
Turn Signal Lamps—Spaced Less than 100 mm from Headlamp	I2
(I-3 thru I-8) See SAEJ759 Oct. 8 for Update Turn Signal Flasher	J590
Hazard Warning Signal Flasher	J945
Warning Lamp Alternating Flasher	J1054
Front Cornering Lamps	K
Rear Cornering Lamps	K2
License Plate Lamps	L
Motorcycle and Motor Driven Cycle Headlamps—Motorcycle Type	M
Motorcycle and Motor Driven Cycle Headlamps—Motor Driven Cycle Type	N
Spot Lamps	O
Parking Lamps	P
Clearance or Side Marker or Identification Lamps	P2
Combination Clearance and Side Marker Lamps	PC
Turn Signal Operating Units—Class A	Q
Turn Signal Operating Units—Class B	QB
Vehicular Hazard Warning Signal Operating Unit	QC
Backup Lamps	R
Stop Lamps	S
Truck Stop Lamps	S2
Tail Lamps	T
Supplemental Dual High Mounted Stop and Turn Signal Lamps	U
Supplemental Center High Mounted Stop Lamps for Trucks	U2
Center High Mounted Stop Lamps for Cars	U3
Warning Lamps for Emergency Maintenance and Service Vehicle	W
Warning Lamps for School Buses	W2
360 Degree Emergency Warning Lamps	W3
Emergency Warning Device	W4
Driving Lamps	Y
Auxiliary Low Beam Lamps	Z

9. Lighting Terms and Definitions

Asymmetrical Beam (nonsymmetrical)

An asymmetrical beam is one in which both sides are not symmetrical with respect to the medial vertical plane of the beam. All lower beams are asymmetrical.

Backup Lamps

Lamps used to provide illumination behind the vehicle and to provide a warning signal when the vehicle is in reverse gear.

Cornering Lamps

Steadily burning lamps used when the turn signal system is operating to supplement the headlights by providing additional road illumination in the direction of the turn. Cornering lamps are mounted on the side at the front and also may be mounted on the side at the rear.

Daytime Running Lights (DRL)

Steady burning lamps that are used to improve the conspicuity of a vehicle from the front and front sides when the regular headlamps are not required for driving.

Discharge Forward Lighting (DFL) System

An automotive lighting system that provides forward illumination comprised of headlamps, discharge source, ballast/starting system and interconnecting wiring.

Discharge Source

An electric light source in which light is produced by a stabilized arc.

Driving Lamps

Auxiliary lamps or lamp that may be used to supplement the upper beam of the regular headlamps.

Emergency Warning Lamps

Lamps that provide a flashing light to identify an authorized vehicle on an emergency mission. The emergency signal may be either a rotating beacon or pairs of alternately or simultaneously flashing lamps.

Fog Lamps

Lamps that may be used with or instead of the lower beam headlamps to provide illumination during rainy, snowy, dusty or foggy conditions.

Halogen Sealed Beam Unit

An integral and hermetically sealed optical assembly containing a halogen inner bulb.

Hazard Warning Lamps

These are turn signal lamps that flash simultaneously to warn others of a hazard involving the vehicle.

Headlamp Lower Beam

Provides illumination ahead of the vehicle and directs light so as to avoid causing glare in the eyes of oncoming drivers. Lower beam headlamps are intended for use in congested areas and on highways when other vehicles are within a distance of 500 feet (150 m).

Headlamp Upper Beam

Upper beam headlamps are intended primarily for distance illumination and for use on the open highway when other vehicles are not encountered.

High Intensity Discharge

A term used to describe any number of high efficiency, contained arc devices that emit light.

Indicator Lamps

Lamps visible to the vehicle operator that indicate:

1. Appropriate electrical circuits are in operation.
2. A malfunction in the vehicle performance.
3. A requirement for remedial action by the vehicle operator.

Integral Beam

A new term for new sealed beams that are carried under a new United States Motor Vehicle Safety Standard (FMVSS No. 108) definition and the Canadian Motor Vehicle Safety Standard (CMVSS No. 108.)

Lane Changer

A device, usually incorporated in the turn signal switch, which will activate the turn signal lamp when held by the driver. It is intended for momentary use when signaling a lane change. When released by the vehicle operator, it will return to neutral and deactivate the signal lamp.

License Plate Lamps

Lamps used to illuminate the license plate on the rear of a vehicle.

Operating Units or Switches

Devices by which the functioning of lamps are controlled.

Parking Lamps

Lamps used to designate the front of a parked vehicle.

Passing Lamp (Auxiliary Low Beam)

An auxiliary lamp or lamps that may be used to supplement the low beam of a standard headlamp system. It is not intended for winding roads or congested city areas.

Replaceable Bulb Headlamp

A headlamp unit comprised of one or two replaceable standard light sources such as a bulb and a headlamp housing or a lens/reflector unit.

SAE Lighting Identification Code

A series of standardized markings for lighting devices that a manufacturer or supplier may use to indicate the SAE Lighting Standard or Standards for a particular device. The code is not intended to limit the manufacturer or supplier from applying other markings to lighting devices.

Sealed Beam Headlamp Assembly

A major lighting device used to provide general illumination ahead of the vehicle. It consists of the following:

- One or more sealed beam units (bulb assembly);
- The means for mounting the device securely to the vehicle; and
- The means to permit required aim adjustment.

Sealed Beam Unit

An integral and hermetically sealed optical assembly with the name Sealed Beam molded in the lens.

Sealed Beam Unit 5-3/4 Inch Type 1, 1C or 2C1

A sealed unit 146 mm in diameter with two filaments. One filament provides the lower beam, and the other provides fill-in light for the upper beam. The unit is aimed on the lower beam.

Sealed Beam Unit 7 Inch Type 2, 2D or 2D1

A sealed unit 177 mm in diameter that provides upper and lower beam. Two similar units are used on a vehicle. This unit is aimed on the lower beam.

Sealed Beam Unit 7 Inch (no identifying number on lens)

A sealed unit 177 mm in diameter that provides an upper and lower beam. Two similar units are used on a vehicle. This is an obsolete unit no longer installed during production. It should be aimed on the upper beam.

Sealed Beam Unit 100 x 165 mm Rectangular Type 1A or 1A1 or 1G1

A sealed 100 x 165 mm rectangular headlamp unit that has a single filament and provides only an upper beam of light.

Sealed Beam Unit 100 x 165 mm Rectangular Type 2A or 2A1 or 2G1

A sealed 100 x 165 mm rectangular headlamp unit that has two filaments. One provides the lower beam, and the other provides fill-in light for the upper beam. It is aimed on the lower beam.

Sealed Beam Unit 100 x 165 mm Rectangular Type 2E1 or 2H1

A sealed 100 x 165 mm rectangular headlamp unit that has two filaments. One provides the lower beam, and the other provides fill-in light for the upper beam. It is aimed on the lower beam.

Sealed Beam Unit 142 x 200 mm Rectangular Type 2B or 2B1

A sealed 142 x 200 mm rectangular headlamp unit that has two filaments. One provides the lower beam, and the other provides fill-in light for the upper beam. It is aimed on the lower beam.

Sealed Beam Unit 92 x 152 mm Rectangular Type LF

A sealed rectangular headlamp unit that has a single filament and provides only a lower beam of light.

Integral Beam Unit 55 x 135 mm Rectangular Type LK

A sealed rectangular headlamp unit that has a single filament and provides a lower beam of light and a fill-in upper beam. Aim on the low beam only.

Integral Beam Unit 55 x 135 mm Rectangular Type UK

A sealed rectangular headlamp unit that has a single filament and provides only an upper beam of light.

Sealed Beam Unit 92 x 150 mm Rectangular Type UF

A sealed rectangular headlamp unit that has a single filament and provides only an upper beam of light.

Side Marker Lamps

Lamps near the front and rear, on the left and right sides, beamed toward the side. For vehicles over 30 feet (9 m) in length, they are also located at the midpoint (intermediate side marker).

Standard Replaceable Light Source

An assembly of a headlamp halogen bulb and base for use with replaceable bulb headlamps. The bulb may have one or two filaments that provide lower beam or upper beam, or both, depending on the application.

Stop Lamps

Lamps that give a steady warning light to the rear of a vehicle to indicate the intention of the vehicle operator to reduce speed or stop.

Symmetrical Beam

Both sides of a symmetrical beam are symmetrical with respect to the median vertical plane of the beam. Lamps that have symmetrical beams include:

- 5 3/4 inch type 1, 1C or 1C1
- 5 3/4 inch type 2, 2C or 2C1 (upper beam filament)
- 100 x 165 mm Type 1A or 1A1
- 100 x 165 mm Type 2A or 2A1 or 2G1 (upper beam filament)
- 100 x 165 mm Type 2E1 or 2H1 (upper beam filament)
- All 7 inch sealed beam units (upper beam filament)
- 92 x 150 mm Type UF
- Type 2B or 2B1 (upper beam filament)
- Replaceable bulb headlamp (upper beam filament)

Tail Lamps

Lamps used to designate the rear of a vehicle

Turn Signal Lamps

Lamps that provide a flashing warning light to indicate the intended direction of the turn.

10. Electrical Systems

To save time, the inspector should develop a plan or sequence for checking miscellaneous electrical items. With practice, many of these items can be inspected when other items are checked.

A. HORN

Procedure

Check the horn to ensure that it is securely fastened and working properly.

Reject the vehicle if:

- The horn is loose or fails to function.
- The horn actuator(s) is not readily accessible to the driver.

B. ELECTRICAL SWITCHES

Procedure

Check all electrical switches to make sure they are functioning properly.

Reject the vehicle if:

- The switches fail to function or a turn signal switch fails to cancel (if so designed).

C. ELECTRICAL WIRING

Procedure

Check to make sure that the visible portion of the wiring harness is not damaged.

Reject the vehicle if:

- The wiring insulation is worn or the wire is broken, rubbed bare or shows any evidence of burning or short-circuiting.

D. ELECTRICAL CONNECTIONS

Procedure

Check to ensure that visible connectors are tight and secure.

Reject the vehicle if:

- The connections show signs of excessive corrosion.
- Bare wires are exposed on the connection terminals.
- The connections used for trailer towing are not made through properly indexed and oriented matched connectors or the permanent connection wires are not properly spliced and insulated.

E. STARTING SYSTEM—AUTOMATIC TRANSMISSIONS ONLY

Procedure

Check the neutral starting system to determine that the starter operates only with the gear selector in "P" and "N." Set the parking brake, place wheel blocks, apply the foot brake and turn on the ignition.

Reject the vehicle if:

- The starter operates with the gear selector in any gear other than "P" and "N."

F. STARTING SYSTEM—STANDARD TRANSMISSION

Procedure

Check to make sure that the engine starts only when the clutch is depressed.

Reject the vehicle if:

- The starter operates without the clutch depressed.

Vehicle Glazing

All motor vehicle glazing is marked with three identifiers: the glazing manufacturer's United States Department of Transportation (DOT) number, the glazing model number M, and the AS number, which indicates where the glazing may be used on the vehicle. AS-1 marked glazing may be used anywhere in a vehicle. AS-2 marked glazing may be used anywhere in a vehicle except for the windshield. (See "Glazing Material Markings" in this section.)

1. Proper Markings

Procedure

Check the glazing materials used on the vehicle for proper markings.

Reject the vehicle if:

- Improper or unmarked glazing materials are used for specific positions.

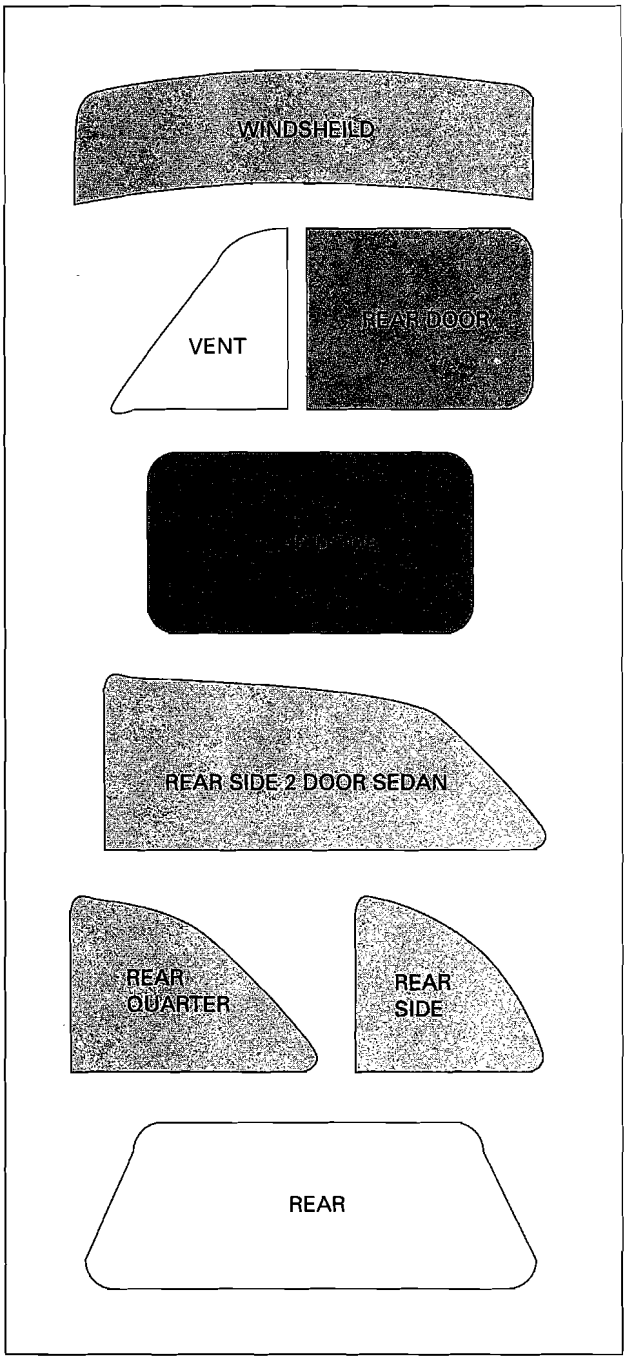
2. Left Front Window

Procedure

Inspect the operation of the window on the driver's left side. The window must open readily.

Reject the vehicle if:

- The window on the driver's left side cannot be readily opened to permit arm signals even though the vehicle has functional turn signals.



Glazing Positions Diagram

3. Stickers and Tinting

Procedure

Inspect all glass for unauthorized materials or conditions that obscure the driver's vision.

Reject the vehicle if:

- Glazed surfaces contain any stickers or other materials not permitted by law or regulation.
- Surfaces contain unauthorized tinting materials.

4. Cracks, Chips and Discoloration

Procedure

Inspect the windshield and all windows for hazardous cracks, chips, sharp edges and discolored glazing. In both Canada and the United States, refer to the ANSI Glazing Standard Z26.1.

Reject the vehicle if:

- There are cracks, discoloration or scratches to the front, right, left or rear of the driver that interfere with the driver's vision.
- Any windows are broken or have exposed sharp edges.
- The rear window is discolored so that the driver does not have a clear view 200 feet (60 m) to the rear of the vehicle.

5. Special Glazing Situations and Positions

A. WINDSHIELD

Star chips or stone nicks larger than 1-1/2 inches (40 mm) in diameter at any location in the unshaded portion of the "Glazing Positions Diagram" in this chapter, should not be permitted.

B. WINDSHIELD, VENT, FRONT DOOR

Discoloration is permitted as the shaded diagram indicates. Any crack or separation that allows one piece of glass to be moved should not be permitted.

C. REAR WINDOW(S)—PASSENGER VEHICLES ONLY

The driver's vision must be clear at least 200 feet (60 m) to the rear of the vehicle.

Note: Convertibles should be inspected with the top in place to verify that the rear window is transparent.

6. Vehicle Glazing—Additional Information

Glazing materials should be marked with AS followed by a number that indicates the position(s) where it may be used on a vehicle. These numbers come from the American National Standards Institute (ANSI) Glazing Standard Z26.1. The numbers have the following meanings:

AS Number	Description
1.	Safety glazing material for use anywhere in a motor vehicle.
2.	Safety glazing material for use anywhere in motor vehicles except windshields.
3.	Safety glazing material for use anywhere in a motor vehicle except windshields and certain specified locations.
4.	Safety glazing material for use in motor vehicles only in specified locations.
5.	Safety glazing material for use in motor vehicles only in specified locations at levels not requisite for driving visibility.
6.	Safety glazing material for use only in house trailers or property-carrying trailers, in the rear windows of convertible passenger car tops, in windscreens for motorcycles, in flexible curtains or readily removable windows, or in ventilators used in conjunction with readily removable windows.
7.	Safety glazing material for use only in house trailers or property-carrying trailers, and at levels not requisite for driving visibility in the rear window of convertible passenger car tops, in windscreens for motorcycles, in flexible curtains or readily removable windows.
8.	Wire glass and multiple glazed units used only in folding doors, standee windows buses, house-or property-carrying trailers, rear of driver in truck or truck tractors, and in rearmost windows in buses. Class 2.
9.	Wire glass and multiple glazed units used only in house- or property-carrying trailers, standee windows in buses and at levels not requisite for driving visibility in folding doors in rear of driver in trucks or truck tractors, and in the rearmost windows in buses.
10.	Bullet-resistant glass for use anywhere in a motor vehicle.
11.	Bullet-resistant glass for use anywhere in motor vehicles except the windshields.
12.	Rigid plastics for use in specific locations not requisite for driving visibility.
13.	Flexible plastic glazing materials—for use in specific locations not requisite for driving visibility.
14.	Glass-plastic glazing materials—for use anywhere in a motor vehicle except in convertibles, vehicles without roofs, or removable roofs.
15A.	(Formerly 15) Annealed glass-plastic glazing—for use in all areas requisite for driving visibility except windshields.
15B.	Tempered glass-plastic glazing for use in all areas not requisite for driving visibility except windshields.
16A.	Annealed glass-plastic glazing for use in all areas not requisite for driving visibility.
16B.	Tempered glass-plastic glazing for use in all areas not requisite for driving visibility.

Note: Glazing material that is intentionally made so that only a portion of a single sheet has a luminous transmittance of not less than 70 percent will be marked at the edge of the sheet. The marks identify the limits of the area that may be used at levels requisite for driving visibility. The marks A1S1, A1S2, etc. are used with the arrow pointing to the portion of the sheet having a luminous transmittance of not less than 70 percent, and the number indicating the item with which that portion of the sheet complies.

Visibility & Interior Body Components

1. Mirrors

All vehicles are equipped at the factory with a left-hand exterior rearview mirror with unit magnification if they were manufactured:

In the United States after January 1, 1968.

In Canada after January 1, 1971.

A. LEFT-HAND EXTERIOR REARVIEW MIRROR

Procedure

From the driver's position, visually inspect the exterior mirror on the driver's side for a clear and reasonably unobstructed view to the rear. Look for correct location, stable mounting, cracks, sharp edges, unnecessary protrusion and ease of proper adjustment.

Reject the vehicle if:

- The mirror is loose enough that rear view vision could be impaired.
- The mirror is cracked, pitted or clouded to the extent that rear view vision is obscured.
- The mirror is obscured by an unwiped portion of the windshield. This applies to vehicles built *after* January 1, 1968, only.
- The mirror cannot be adjusted or will not maintain a set adjustment.

B. INTERIOR REARVIEW MIRROR

Procedure

From the driver's position, visually inspect the interior mirror for proper mounting, location, cracks, sharp edges and ease of adjustment.

Reject the vehicle if:

- The mirror is loose enough to impair the rear view vision.
- The mirror does not provide a clear view of the highway at least 200 feet (60 m) to the rear.
- The mirror is cracked, broken, has sharp edges, or cannot be cleaned in such a way that the rear view vision is obscured.
- The mirror cannot be adjusted or will not maintain a set adjustment.

C. RIGHT-HAND EXTERIOR REARVIEW MIRROR

Procedure

In Canada, inspect for the presence of a right-hand exterior rearview mirror.

Reject if:

- The right-hand exterior rearview mirror is missing on multipurpose passenger vehicles manufactured on or after September 1, 1988.

2. Windshield Wipers, Washer, Defroster, Heater, Visors and Seats

All vehicles produced after January 1, 1968, must be equipped with a windshield wiper system capable of operating on two or more speeds and a windshield washer system. A cycle must consist of blade movement from one extreme of the wiper pattern to the other and return.

It is very important that the windshield defroster be given a minimum inspection as described in this section. All United States vehi-

cles produced after January 1, 1969, and all Canadian vehicles must be equipped with windshield defroster systems.

A. WINDSHIELD WIPER OPERATION

Procedure

Inspect for satisfactory operation. The windshield and blade rubber element must be free of insects, oil film or other foreign matter and must be continuously wet when tested.

Reject the vehicle if:

- Wipers do not operate at a minimum speed of 20 cycles per minute.
- The system does not park when it is turned off.
- The system does not function at high and low speeds.

B. DAMAGED BLADES

Procedure

Inspect the wiper blades and observe if they are cracked, torn or hardened.

Reject the vehicle if:

- The rubber wiper blades show signs of physical deterioration.

C. DAMAGED METAL PARTS

Procedure

Inspect the wiper blades and arms for damaged metal parts.

Reject the vehicle if:

- Parts of the blades or arm are missing, bent, broken or loose.

D. BLADE AND WINDSHIELD CONTACT

Procedure

Inspect for proper contact between the blades and the windshield. Raise the arm away from the windshield and release it. The arm should return and the wiper blade should contact the windshield firmly.

Reject the vehicle if:

- The blade fails to contact the windshield firmly and fully throughout the cycle of the system.

E. WINDSHIELD WASHER SYSTEM

Procedure

Inspect for the proper operation of the hand or foot control and the delivery of an effective amount of fluid to the outside of the windshield opposite the driver and front seat passenger.

Advise the driver:

- If the fluid level is low.

Reject the vehicle if:

- The system fails to function.
- The system does not clean an effective wash area within 10 wiper cycles.

F. WINDSHIELD DEFROSTER

The engine must be warm and all elements of the defroster system must be on during this inspection.

Equipment needed: Ribbons may be used to check air movement.

Procedure

Turn the windshield defroster fan switch to high blower speed and check to see if heated air blows over the inside of the windshield, covering the areas directly in front of the driver and the front seat passenger.

Reject the vehicle if:

- The defroster fan fails to function.
- The fan functions, but the inspector cannot feel a stream of air blowing against the windshield from all vents.

G. SUN VISORS

Procedure

Inspect the sun visors for broken, bent or loose parts that prevent the visors from being positioned, and check to see that the visors will stay in a set position.

Advise the driver if:

- The driver's visor is missing.
- The visor cannot be positioned to protect the driver's eyes from the sun.
- The vibration from the running engine causes the visors to move from a set position.

H. SEATS

Procedure

Inspect the operation of the seat adjusting mechanisms and observe if the seats are securely anchored to the floor pan.

Reject the vehicle if:

- Any seat anchor tracks are missing or not securely fastened to the floor.
- The seat position or recliner adjustment mechanism slips out of the set position, without being released at the mechanism control.

I. HEAD RESTRAINTS

Procedure

Inspect for head restraints on the front seats of passenger cars manufactured after 1968.

Reject the vehicle if:

- Any metal components are exposed because of covering material that is missing, insecurely mounted or torn.
- Head restraints for front seat occupants are missing or insecurely mounted.

Occupant Restraint Systems

All vehicles produced since January 1, 1968, must have manual safety belt systems. Since September 1, 1986, car manufacturers have been phasing in automatic crash protection devices including air bags and automatic belts. Since September 1, 1989, all new cars sold in the United States are required to have automatic crash protection systems as standard equipment.

1. Manual Safety Belts

Procedure

Inspect the safety belts for frayed, split or torn webbing; malfunctioning buckles or retractors; and loose or damaged anchors or floor pan.

Advise the driver if:

- The belt warning system (chimes, buzzer) is inoperative.

Reject the vehicle if:

- Required equipment is not present.
- The safety belt webbing is frayed, split, torn or burned.
- Belt buckles or retractors do not operate properly.
- Belt anchors are loose, badly corroded, missing or not fastened to the belt.
- Belt mounting surfaces are badly deformed, damaged or corroded.

2. Motorized Automatic Safety Belts

Procedure

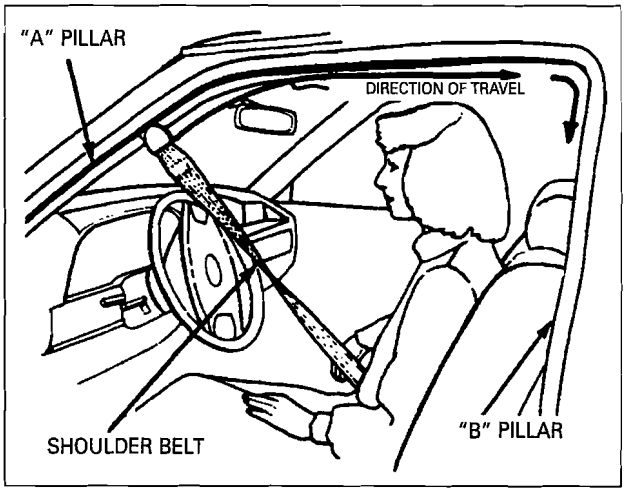
Step 1: Check to see that the warning system activates a continuous or intermittent audible signal for not less than four seconds and not more than eight seconds when the belt is disconnected or the door is open.

Step 2: Check to see if a continuous or flashing warning light is visible to the driver for not less than 60 seconds.

Step 3: When the ignition is turned to the "OFF" position and the door is opened, observe if the shoulder belt moves forward to the "A" pillar as indicated in the "Motorized Safety Belt System" diagram in this section.

Reject the vehicle if:

- The safety belts do not move when the door is closed, or the audible signal and/or warning light continues after the belt has completed its travel.
- The required equipment is not present.



Motorized Safety Belt System

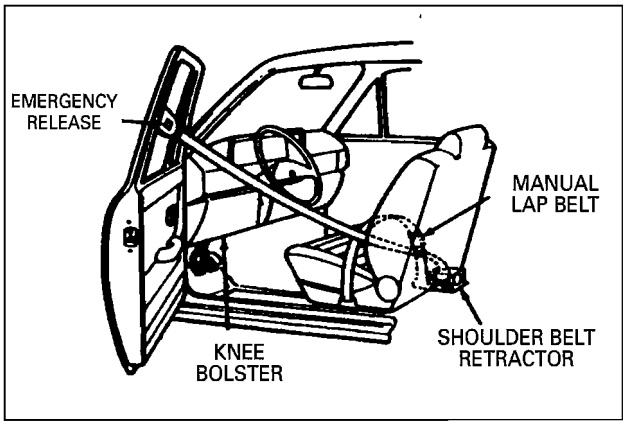
3. Non-motorized Automatic Safety Belts

Procedure

The lap and shoulder belts are connected to the door. The inspector should slide in behind the belts and close the door. Observe if the belts move into position automatically. In some models the lap belt must be secured manually.

Reject the vehicle if:

- The safety belts do not move or the audible signal and warning light continues.



Non-motorized Shoulder Belt and Knee Bolster

4. Air Bag Readiness Light

Procedure

Turn the ignition key to the "ON" position. The air bag readiness light will indicate normal system readiness for operation, as prescribed by the manufacturer.

Reject the vehicle if:

- The air bag indicator lamp fails to light in the manner prescribed by the manufacturer.

CHAPTER 10

Exterior Body Parts, Doors, Hood & Sheet Metal

Vehicles may be rejected if body exterior components and sheet metal parts are damaged or dislocated so that they protrude from the vehicle and present a hazard to occupants, pedestrians and other vehicles.

1. Protruding Metal

Procedure

Inspect for torn metal parts, moldings, etc., which may protrude from the vehicle.

Reject the vehicle if:

- Torn metal, glass or other loose or dislocated parts protrude from the surface of the vehicle causing a hazard to pedestrians or cyclists.

2. Bumpers

Procedure

Inspect the bumpers for hazardous conditions or unsafe mountings.

Advise the driver if:

- The bumper is loose or if an energy absorbing unit is stuck in the recoiled position.

Reject the vehicle if:

- The bumper is missing, badly displaced, loosely attached or a broken or torn portion is protruding and creating a hazard.

  WARNING: The inspector should stay clear of a recoiled type bumper that was hit and is stuck in the recoil position. It could snap suddenly back into normal position with enough force to cause injury. Advise the driver to have the energy absorbing units serviced in accordance with the manufacturer's recommended procedure.

3. Hood

Procedure

Step 1: Open the hood and inspect the safety catch and hinges for proper operation.

Step 2: Close the hood and observe if it closes completely.

Step 3: Manually inspect the latch or remote control for proper operation.

Advise the driver if:

- Latches or controls are difficult to operate.
- Excessive pressure must be used to fully close the hood.

Reject the vehicle if:

- The hood latch does not securely hold the hood in its proper, fully-closed position.
- The secondary or safety catch does not function properly.
- The latch release mechanism or its parts are broken, missing or badly adjusted so that the hood cannot be opened and closed properly.

4. Doors, Tailgates and Liftgates

Procedure

Step 1: Operate the doors and locks.

Step 2: Inspect the door latches, locks, hinges and handles for proper operation, fastening, bad adjustment, broken or missing components.

Advise the driver if:

- Extra effort is required to close a door because the door latching device is out of adjustment.

Reject the vehicle if:

- The doors or door parts are missing, broken or misaligned so that the door cannot be tightly closed.

5. Fenders

Procedure

Inspect the front and rear fenders.

Advise the driver that:

- All required items such as tail, stop and turn lamps, etc., must be properly mounted on replacement fenders.

Reject the vehicle if:

- Any fender is missing.
- Any lighting equipment is missing.

6. Floor Pan and Inner Panels

Procedure

Inspect the floor pan and the inner panels in both the occupant compartment and the trunk for areas that have rusted-out, for openings that could permit the entry of exhaust gases, or for areas that would not support the occupants adequately.

Reject the vehicle if:

- The floor pan or inner panels are visibly perforated by rust or have any openings other than those intended by the manufacturer, or if exhaust gases can enter either the occupant compartment or the trunk.

CHAPTER 11

Fuel & Exhaust System

1. Fuel System

The fuel system includes the fuel tank and the components necessary to carry the fuel from the tank to the engine and back to the tank. It also includes the fuel vapor lines from the tank to the canister and from the canister to the air intake system.

Note: Vehicles with pressurized fuel systems (e.g., most vehicles equipped with fuel injection systems) should be examined with the engine running.

Procedure

Visually examine the fuel tank, fuel tank support straps, filler tube (rubber, plastic, metal), tube clamps, fuel tank vent hoses or tubes, filler housing drain, overflow tubes and filler cap.

Reject the vehicle if:

- Any part of the system is not securely fastened.
- There is vapor or liquid fuel leakage.
- The fuel tank filler cap is missing.
- The fuel hoses or tubes are contacting moving components or extreme heat areas.

2. Exhaust System

The exhaust system may include exhaust pipes, a catalytic converter, mufflers, resonators and tail and connecting pipes in various combinations.

Procedure

Step 1: With the vehicle on a hoist or resting over a pit, visually examine, as applicable, the mufflers, resonators, tail pipes, exhaust pipes, catalytic converters (air hoses), heat shields and supporting hardware.

Step 2: Closely examine any rusted or corroded surfaces.

Note: Holes in the system made by the manufacturer for drainage are not cause for rejection.

Advise the driver if:

- There is excessive rust or corrosion.

Reject the vehicle if:

- The vehicle is not equipped with a proper exhaust system.
- There are loose or leaking joints.
- There are holes caused by corrosion, leaking seams or patches on exhaust components.
- The end of the tail pipe does not exhaust fumes beyond the passenger-carrying compartment.
- The components of the system are not securely fastened.
- There is an exhaust system cut out or similar device that allows excessive noise.
- Any part of the system passes through the occupant compartment.

3. Exhaust Gas Caution

Procedure

Inspect for openings in the body of the vehicle, especially open tailgate windows and doors in station wagons, caused by accident damage, rubber seal damage or failure, deck lid latch or lock failure. THIS CAN CAUSE EXHAUST GASES TO ENTER THE PASSENGER COMPARTMENT. These gases contain carbon monoxide and can cause sickness or unconsciousness and can be lethal. This also can happen during periods of extended idling when the vehicle is stationary, or when tailgate windows or doors are open while the engine is running.

Advise the driver if:

- The rear tailgate window of a station wagon is open or if the vehicle is being driven when the deck lid is not fully closed.

Reject the vehicle if:

- The vehicle is damaged so that the rear doors, windows, deck lids, etc., cannot be fully closed and properly sealed.

CHAPTER 12

Presence of Emissions Control Components

Inspecting for the presence and condition of emissions components should be performed as part of the vehicle inspection. Emissions Inspection and Maintenance (I/M) program testing also may be required by some jurisdictions. The AAMVA Engineering and Vehicle Inspection Committee recommends that safety and emissions inspections should be provided at the same time at the same location.

For additional information about emissions testing, procedures and regulations, refer to appropriate sections of the *Emissions Inspection Handbook.*

Emissions Control Components

Procedure

Conduct a visual inspection for the presence and condition of the fuel inlet restrictor, catalytic converter, exhaust gas recirculation (EGR) system, thermal reactor, positive crankcase ventilation valve, air injection system and evaporative canister.

Reject the vehicle if:

- Any emissions components are missing, disconnected, broken or loose.
- Any emissions component has been rendered inoperative.
- There is any evidence of tampering.
- Any hoses or wires are not connected or are cracked.

About the Publishers

American Association of Motor Vehicle Administrators

Founded in 1933, AAMVA is a nonprofit, educational organization representing state and provincial motor vehicle and law enforcement agencies throughout the United States and Canada.

AAMVA's programs encourage uniformity and reciprocity among the states and provinces, and promote liaison activities with other levels of government and the private sector. AAMVA also stresses highway safety through its involvement in numerous national coalitions, and its program and research activities provide guidelines for more effective public service.

Association members include all United States and Canadian jurisdictions plus American Samoa, Guam, Puerto Rico and the Virgin Islands. AAMVA associate members include organizations, associations and business enterprises with interests compatible with AAMVA and its program objectives.

Canadian Council of Motor Transport Administrators

Established by the provincial, territorial and federal governments, CCMTA is a nonprofit organization that promotes understanding and cooperation in all matters concerning the administration, regulation and control of motor vehicle transportation and safety in Canada.

CCMTA reports to the Council of Ministers Responsible for Transportation and Highway Safety and is responsible for motor vehicle registration, driver licensing, road safety programs, motor carrier regulatory issues, compliance activities for commercial vehicles and drivers, and other transportation projects and agreements.

Members include senior representatives from all of the provincial and territorial governments, as well as representatives from the federal government. Private industry organizations and other government agencies in Canada and the United States participate as associate members.

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